TOWN OF ERIE

Meeting Agenda

Town Council

Tuesday, February 3, 2026	**6:00 PM**	**Council Chambers**

Study Session

Link to Watch Virtually: www.erieco.gov/CouncilMeeting

I. Discussion Items

2026-67   Extended Producer Responsibility Discussion

Attachments: Presentation

CAA Colorado Program Plan

EPR Overview

6:00-7:00 p.m.
Presenter(s): Emma Marino, Sustainability & Water Conservation Specialist
Eryka Thorley, Sustainability Division Manager

2026-68   Resilience Action Plan Next Steps

Attachments: RAP Presentation

Draft Resilience Action Plan

Cost Impact of Energy Efficiency Codes and Building Electrification Memo 1.30.

RMI_Economics_of_Electrifying_Buildings_2018

7:00-7:15 p.m.
Presenter(s:) Emma Marino, Sustainability & Water Conservation Specialist
Eryka Thorley, Sustainability Division Manager

II. Adjournment

7:15 p.m.

*(The Town Council's Goal is that all meetings be adjourned by 10:30pm. An agenda
check will be conducted at or about 10:00 p.m., and no later than at the end of the first
item finished after 10:00 p.m. Items not completed prior to adjournment will generally be
taken up at the next regular meeting.)*

TOWN OF ERIE

Town Council

Board Meeting Date: 2/3/2026

File #: 2026-67, **Version:** 1

SUBJECT:
Extended Producer Responsibility Discussion

DEPARTMENT: Environmental Services

PRESENTER(S):   Emma Marino, Sustainability & Water Conservation Specialist
Eryka Thorley, Sustainability Division Manager

TIME ESTIMATE: 60 minutes

FISCAL SUMMARY:
N/A

POLICY ISSUES:
Waste diversion is a key priority outlined in the 2019 Sustainability Plan with emissions from waste being the single largest greenhouse gas emission source in Erie.

STAFF RECOMMENDATION:
Staff recommend that Council receive at a minimum yearly presentations or memos about the Extended Producer Responsibility program.

SUMMARY/KEY POINTS
- The Town and its residents can receive funding and reimbursements as part of the Extended Producer Responsibility program (EPR) operated by the State to offset the cost of recycling.
- Funding is collected from consumer products producers and will then be issued as reimbursements to eligible organizations (waste collectors, recycling transfer station operators like the Erie Recycling Center, materials recovery facilities, etc.), reimbursements are expected later in 2026.
- Haulers are not required to participate, so staff recommends residents confirm what they are paying for recycling services today and request their waste hauler participate.

BACKGROUND OF SUBJECT MATTER:
On June 3, 2022, the Producer Responsibility Program for Statewide Recycling Act, House Bill 22-1355 <https://leg.colorado.gov/bills/hb22-1355>, was signed into law. It established a Producer Responsibility program that requires companies that sell products in packaging and paper products

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to fund a statewide recycling system to recycle those materials. This program, referred to as Extended Producer Responsibility (EPR), requires related companies to form a Producer Responsibility Organization (PRO) that coordinates, funds, and manages this statewide recycling system.

Circular Action Alliance (CAA) was appointed as the PRO for Colorado and created a program plan that was adopted by the State in late 2025. The first phase of the plan is targeted towards residential recycling, including reimbursement for recycling drop off facilities, like the Erie Recycling Center. Funds are expected to be distributed in late 2026, but the timeline will depend on the fees collected by CAA. The waste collectors that service Erie are not required to participate, but staff want to ensure residents are able to advocate for themselves to receive this discount on their recycling services moving forward. EPR aims to make recycling as convenient as trash service and introduces free recycling services for residents, with improvements rolling out over time.

Beginning with residential cost offsets in 2026, EPR will expand to commercial and school reimbursements in 2028 and small businesses in 2030. Some details are still being negotiated, but Erie will likely see $2-3 per household in outreach and education funds to support communicating with residents and other relevant entities starting in late 2026. Current discussions involve collaborating with the Boulder County Resource Conservation Division and EcoCycle on outreach and education efforts, prioritizing consistent messaging and coordination with neighboring jurisdictions.

Waste Collection Data

To better understand the significance of recycling reimbursements in Erie, it's helpful to understand previous waste diversion efforts and collected data, specifically the 2023 Community Survey results as well as an informal questionnaire conducted in 2024/2025 in which 232 people participated. The 2023 Community Survey showed that 89% of residents have access to curbside trash and recycling pickup, 51% of residents would be interested in a Town coordinated pickup if it were to be priced competitively based on what they pay currently, and 68% of respondents have their waste hauling managed by their HOA, so they don't currently have a choice as to who they contract with for their services.

An informal questionnaire shared with households went a bit deeper and showed that 70% of respondents did not know what they currently pay for hauling services as it is contracted by their HOA. This information indicates that to maximize recycling reimbursements and cost reductions for residents, it's imperative that staff communicate with HOAs and residents to identify their *current* recycling costs and even advocate for new contracts for the 11% of Erie households who may not have current curbside recycling services.

ATTACHMENT(S):
1. Presentation
2. CAA Colorado Program Plan
3. EPR Overview

Extended Producer Responsibility (EPR) Discussion

Town of Erie Study Session

Feb. 3, 2026

Emma Marino, Sustainability & Water Conservation Specialist

Eryka Thorley, Sustainability Manager

Tonight's Agenda

- Erie waste overview
- Extended Producer Responsibility (EPR) overview
- EPR applications in Erie
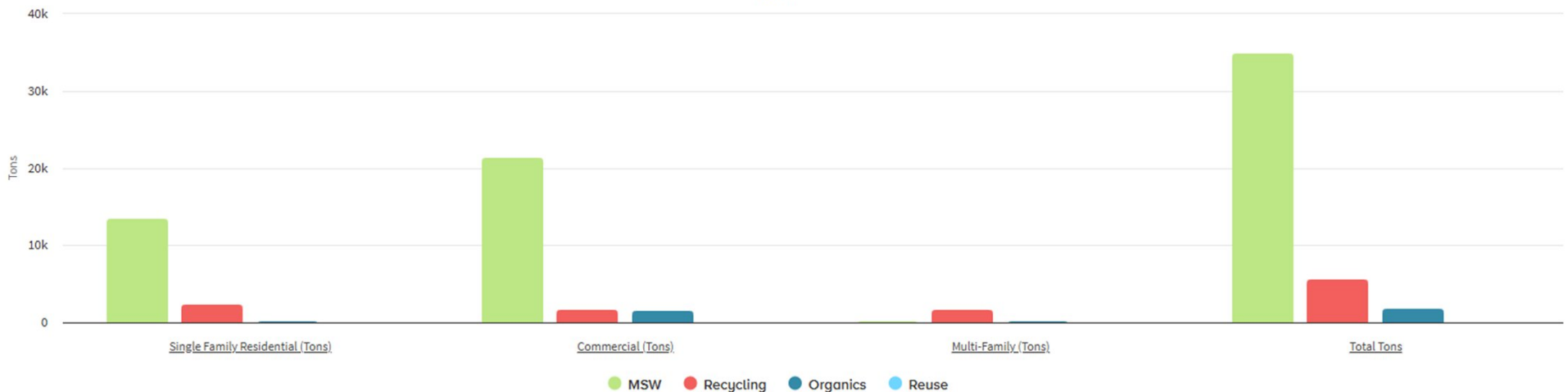- Council discussion
- Next steps

| Reimburse for Existing Curbside Service | Boost Participation Where Access Exists | Build Capacity in Underserved Areas | Enhance Systems & Recycle More Items | By 2030, recycling should be just as convenient as trash pickup, no matter where you live. |

How EPR Supports Colorado's Communities
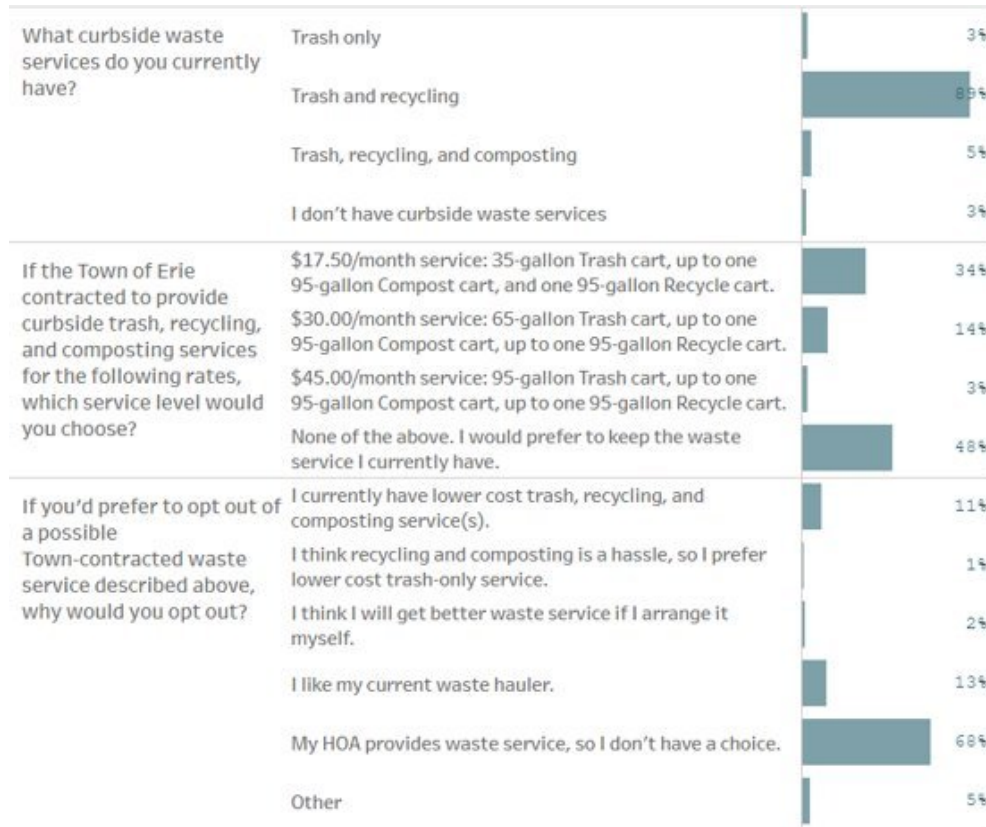
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Erie Waste Overview

- Five residential haulers within the Town (One Way, Republic, Waste Connections, Western Disposal, WM)
  - Compost haulers (Wompost + Compost Colorado, Scraps)

- Home to three landfills:
  - Front Range Landfill
  - Denver Regional North (CLOSED)
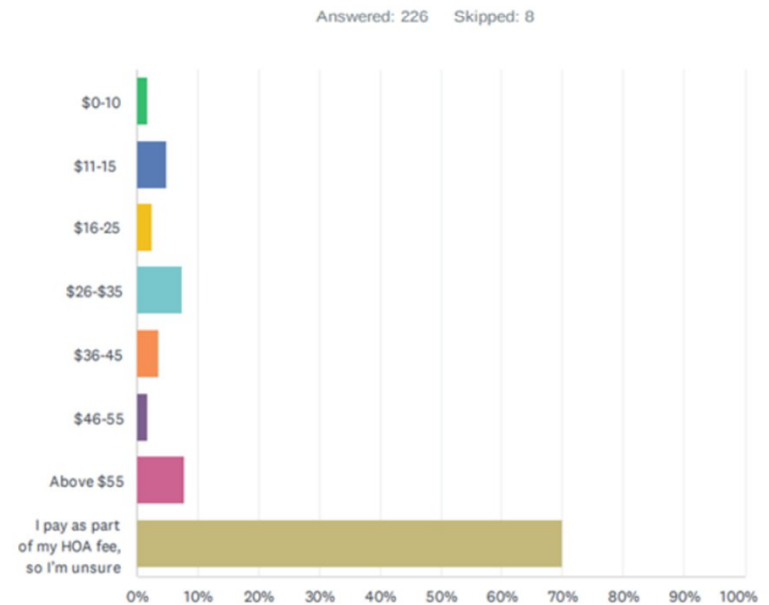 - Denver Regional South (CLOSED)

Diversion Report
2024

Legend: MSW · Recycling · Organics · Reuse

Categories: Single Family Residential (Tons), Commercial (Tons), Multi-Family (Tons), Total Tons

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2023 Community Survey Results:

'24/'25 Informal Questionnaire Results:

What curbside waste services do you currently have?	Trash only	3%
	Trash and recycling	89%
	Trash, recycling, and composting	5%
	I don't have curbside waste services	3%
If the Town of Erie contracted to provide curbside trash, recycling, and composting services for the following rates, which service level would you choose?	$17.50/month service: 35-gallon Trash cart, up to one 95-gallon Compost cart, and one 95-gallon Recycle cart.	34%
	$30.00/month service: 65-gallon Trash cart, up to one 95-gallon Compost cart, up to one 95-gallon Recycle cart.	14%
	$45.00/month service: 95-gallon Trash cart, up to one 95-gallon Compost cart, up to one 95-gallon Recycle cart.	3%
	None of the above. I would prefer to keep the waste service I currently have.	48%
If you'd prefer to opt out of a possible Town-contracted waste service described above, why would you opt out?	I currently have lower cost trash, recycling, and composting service(s).	11%
	I think recycling and composting is a hassle, so I prefer lower cost trash-only service.	1%
	I think I will get better waste service if I arrange it myself.	2%
	I like my current waste hauler.	13%
	My HOA provides waste service, so I don't have a choice.	68%
	Other	5%

Q15 How much do you pay for the services provided by your hauler?

Answered: 226   Skipped: 8

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Extended Producer Responsibility (EPR)

- On June 3, 2022, the Producer Responsibility Program for Statewide Recycling Act, House Bill 22-1355, was signed into law. It sets up a Producer Responsibility program that requires companies that sell products in packaging materials and paper products to fund a statewide recycling system to recycle those materials.

- Related companies were required to form an independent non-profit organization, called a Producer Responsibility Organization (PRO), to coordinate, fund, and manage this statewide recycling system.
  - Circular Action Alliance (CAA) was appointed as the PRO in Colorado.

Extended Producer Responsibility (EPR)

- EPR aims to make recycling as convenient as trash service and gradually introduces free recycling services for residents, with improvements rolling out over time.

- The program covers packaging and paper products and will offer a standardized list of recyclable materials collected statewide.

- Benefits for Colorado include less landfill waste, no-cost recycling access for residents, local business growth and education for residents.

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Circular Action Alliance (CAA)

- As the PRO, CAA is responsible for developing and implementing a Program Plan for managing covered products.

End Markets
REM verification, investment, and opportunity for producers to purchase PCR.

Compost Facilities
Funding to reduce contamination and increase recovery of covered materials.

Post Collection
Investment to expand capacity, materials, and efficiency.

CAA to reimburse 100% net service costs, including expansion.

Collection
Services provided by local governments, non-profits, and private business.

Producers
Producers fully fund the recycling services and infrastructure in Colorado.

Financing
Obligated producers pay dues, dues vary by type of covered material.

Covered Entities
Recycling services are provided to covered entities at no cost.

Education and Outreach
Statewide education and outreach campaign led by CAA.

Circular Action Alliance

Colorado EPR Flow Diagram

HOW EPR WORKS IN COLORADO

PRODUCER RESPONSIBILITY

Companies selling packaging and paper in Colorado pay dues based on the type and amount of materials they provide. These dues fund the full recycling system, including collection, processing, education and infrastructure.

CENTRALIZED, STATEWIDE SYSTEM

CAA Colorado will coordinate statewide recycling by partnering with local governments, private providers and community groups. The plan standardizes what materials are recyclable and makes recycling convenient as trash collection.

EXPANDING ACCESS AND SERVICES

Residential & Non-Residential: The program begins with residential recycling and adds schools, government buildings, public areas, hospitality venues and small businesses by 2030.

Rural Investments: Funds will expand or upgrade recycling infrastructure in rural and underserved regions.

Compostable Packaging: The plan supports composting for certified compostable packaging and provides education to reduce contamination and boost recovery.

Reuse and Refill: Incentives for producers to offer at-home refill packaging and innovative designs mean more sustainable choices for consumers.

EDUCATION AND OUTREACH

A key focus is public education, showing people what to recycle, why it matters and how to avoid contamination. Outreach will build on Colorado's successes and be tailored to diverse communities through targeted campaigns, events and partnerships.

INNOVATION AND IMPROVEMENT

CAA Colorado will regularly review and update the program, using data and public feedback to improve recycling rates, add new materials and support innovative solutions like reusable packaging and increased use of recycled content in new products.

What does this mean for Erie?

Council

- Erie will receive reimbursement for Town Recycling Center materials that are currently on the covered materials list of the program plan - single stream recycling (SSR) and cardboard.

- In the future, receive reimbursement for Town facility SSR and cardboard hauling.

- The Town will receive likely $2-3 per household to support education and outreach to residents and later to businesses.

Residents & HOAs

- Confirm that your hauler will be participating in EPR.

- Confirm what you pay for recycling to date.

- Opportunity to explore yard waste/organics collection at your home or HOA.

***Recycling reimbursement to haulers may not be seen until late 2026.

Council Discussion

What questions do you have about EPR?

- How can we best support Council with updates about EPR?
    - Including new waves of participation (i.e. businesses, new covered materials).
- Possible hauler licensing to require EPR participation.

RECYCLING GOALS UNDER EPR

CAA Colorado aims to improve Colorado's low recycling rates and limited recycling access. With producers taking responsibility for their packaging, the program also encourages less waste and more sustainable product design.

Increase recycling rates from 25% to 55% by 2035.

25% 2022   **41%** 2030   **55%** 2035

Next Steps

- Staff will continue to monitor, communicate, and participate in EPR rollout.

HOW IMPLEMENTATION BEGINS

Initiatives will roll out gradually, giving communities and businesses time to adjust to the new system.

Reimburse for existing curbside service

Boost participation where access exists

Enhance systems and recycle more items

Build capacity in underserved areas

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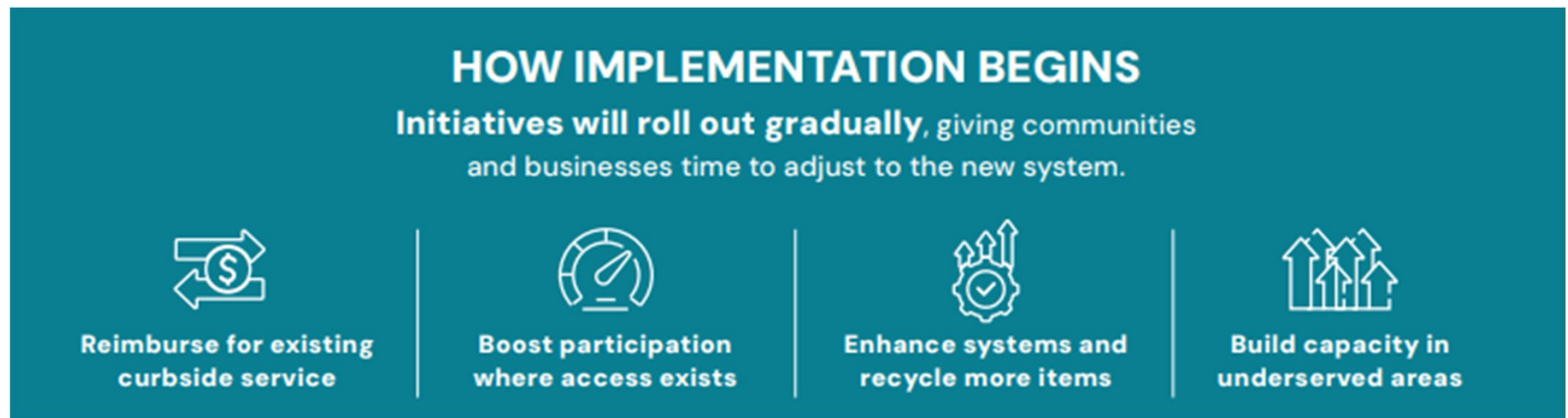
Questions?

- For Erie specific: SustainableErie@erieco.gov
- For State level: eprcomments@state.co.us
- For CAA: coloradoinfo@circularaction.org

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Colorado Program Plan

2026 – 2030

SUBMITTED NOVEMBER 2025

Prepared By:

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Circular Action Alliance®

Table of Contents

Circular Action Alliance
Final Colorado Program Plan 2026 – 2030

Tables and Figures

Guide to the Act's 25-17-705(4) Plan Proposal Requirements

The following guide is to assist the reader in identifying where in the Program Circular Action Alliance satisfies the Act's requirements. Terms specific to the Program are defined in detail within the *Glossary of Term*s Appendix.

The Program must cover a period of five years, and, except as set forth in subsection (4)(z), it only addresses recycling services for residential covered entities. Circular Action Alliance has considered input from the Colorado Department of Health and Environment, the advisory board and interest holders in the development of this final program plan. Opportunities for input are addressed in the following sections: Consultations and Informing the Program and General Communication and Coordination.

Table 1 lists the subsections of 705(4) that describe what the Program proposal must do to be approved, and where to find it in the document.

Table 1: Statutory Directives

705(4) Subsections	Click on the Link to go to Location in this Document
(a) provide contact information for the organization and a representative of the organization;	17.1 Overall Day-to-Day Management
(b) describe how the plan proposal will address and implement the findings of the needs assessment;	5.2 Providing Recycling Services
(c) describe the manner in which the organization solicited and considered input from stakeholders and the advisory board in developing the plan proposal. The organization must provide a summary of any comments about the plan proposal from the advisory board and additional stakeholders and identify changes made to the plan proposal based on the comments.	4 Consultation and Informing the Program
(d) describe how the organization will notify affected producers of their obligations under this part 7;	17.4 Producer Compliance
(e) describe how the organization will track compliance among producers and will collaborate with the executive director to bring producers into compliance;	17.4 Producer Compliance
(f) include a comprehensive list of the covered materials included in the program in accordance with this part 7;	7.1 Covered Materials

(g) establish recycling practices that: (I) meet or exceed the convenience standards; (II) use open, competitive, and fair procurement practices when entering into contracts with service providers, and, when entering into contracts with private service providers, adopt a preference for service providers with strong labor standards and worker safety practices; (III) ensure that any covered materials collected for recycling will be transferred to a responsible end market; and (IV) use environmentally sound management practices;	(g)(I) 5 Operations Plan: Recycling Services Approach (g)(II) 6 Operations Plan: Service Provider Reimbursement (g)(III) 13 Operations Plan: Responsible End Markets (g)(IV) 6 Operations Plan: Service Provider Reimbursement
(h) describe how the organization will work with newspaper publishers and magazine and periodical publishers to accept print or online advertising in lieu of all or a portion of the producer responsibility dues for newspapers, magazines, and periodicals circulated within the state;	Publisher In-Kind in Lieu of Paying Dues (Print and Online Advertising)
(i) establish a funding mechanism that: (I) does not exceed the direct and indirect costs of implementing the program, including the costs of: (A) providing recycling services under the program through contracts with service providers or reimbursement of recycling services costs under the reimbursement rates proposed pursuant to subsection (4)(j) of this section; (B) meeting the reporting requirements set forth in section 25-17-709 (2); (C) conducting the needs assessment; (D) developing and updating the final plan; (E) implementing the education and outreach program set forth in section 25-17-707; (F) reimbursing the department pursuant to section 25-17-715 for its costs in administering and implementing this part 7, including the costs of the advisory board; and (G) reimbursing the department pursuant to section 25-17-715 for the costs of enforcing this part 7 pursuant to section 25-17-710;	15 Program Budget & Producer Dues

(i) establish a funding mechanism that: (II) is funded through producer responsibility dues. The producer responsibility dues must vary by the type of covered material, whether or not the material is readily recyclable, and be based on the net recycling services costs for each covered material in the state. The organization may use up to five percent of the producer responsibility dues collected from producers for administration of the program, over the terms of the program, in accordance with generally accepted accounting principles, but the organization shall not use any producer responsibility dues collected from producers to pay employee bonuses.	15 Program Budget & Producer Dues
(i) establish a funding mechanism that: (III) requires: (A) any surplus money generated by the program to be placed back into the program for program improvements or a reduction in producer responsibility dues; (B) the organization to maintain a financial reserve sufficient to operate the program in a fiscally prudent and responsible manner; and (C) annual updates to the producer responsibility dues schedule to reflect changes in program costs and relevant plan revisions and how the organization will solicit and incorporate input from all producers in setting and revising the annual producer responsibility dues schedule;	15 Program Budget & Producer Dues
(i) establish a funding mechanism that: (IV) includes eco-modulation factors that lower producer responsibility dues to incentivize: (A) reductions in the amount of packaging materials used for products; (B) innovations and practices to enhance the recyclability or commodity value of covered materials; (C) high levels of postconsumer recycled material use; (D) designs for the reuse and refill of covered materials; and (E) high recycling and refill rates of covered materials;	16 Eco-Modulation Approach

(i) establish a funding mechanism that: (V) includes eco-modulation factors that increase producer responsibility dues to discourage: (A) designs and practices that increase the costs of recycling, reusing, or composting covered materials; (B) designs and practices that disrupt the recycling of other materials; and (C) producers from using covered materials that are not on the minimum recyclable list; and	16 Eco-Modulation Approach
(i) establish a funding mechanism that: (VI) at the request of a producer or producers of a covered material, may include a special assessment paid by the producers of that covered material to cover system improvements that improve the collection and recycling of that covered material or facilitate the addition of the covered material to the list of readily recyclable materials;	MRL and AML Collection Approach 15.3 Producer Responsibility Dues

(j) include reimbursement rates for one hundred percent of the net recycling services costs of the recycling services provided by service providers under the program consistent with the requirements of section 25-17-706. The reimbursement rates must: (I) be calculated using an objective cost formula or formulas; (II) incorporate the relevant cost information identified by the needs assessment pursuant to subsection (3)(a)(III) of this section; (III) be calculated on a per unit basis such as per ton, per household, or other unit of measurement; and (IV) take into account: (A) regional recycling services costs; (B) population density; (C) the number and types of households served; (D) the collection method used; (E) the revenue generated from covered materials; (F) the amount of inbound contamination and other factors affecting the quality of covered materials; and (G) other demographic factors identified in the needs assessment pursuant to subsection (3)(a)(III) of this section.	6 Operations Plan: Service Provider Reimbursement
(k) describe the process to evaluate and revise the objective cost formulas as necessary and using documented costs. If the plan proposal includes more than one objective cost formula for recycling services, the plan proposal must describe the conditions under which each formula will be applied.	6.6 Process for Evaluation and Revision of Objective Cost Formulas: Collection Process for Evaluation and Revision: Post-Collection
(I) include a schedule of reimbursement rates for service providers that elect to participate in the program and be reimbursed by the organization for providing recycling services for the program and describe a process for updating the schedule periodically and as necessary;	6.5 Calculation of Net Recycling Cost Reimbursements: Collection

(m) include a proposed budget and a description of the process used to determine producer responsibility dues, including a de minimis level in which no dues are charged and an optional flat rate for producers below a certain size to minimize the administrative and reporting costs of the producers and the organization;	15 Program Budget and Producer Dues
(n) describe a plan that outlines, if the organization ceases to exist or ceases to administer the program, how any producer responsibility dues that have not been used to implement the program will be transferred to another organization designated by the executive director under subsection (1)(b) (II) of this section to administer the program or will be transferred to the fund to be managed by the department until transferred to another designated organization;	Closure Plan
(o) include the minimum recyclable list established in accordance with section 25-17-706 (1)(a);	7.2 Minimum Recyclables List and Additional Materials List
(p) set targets for the minimum collection rates, minimum recycling rates, and minimum postconsumer-recycled-content rates for certain types of covered materials, including paper products, glass, metal, and plastic, that the state will strive to meet by January 1, 2030, and January 1, 2035;	2.2 Collection and Recycling Rate Targets 12 Operations Plan: Postconsumer Recycled Content
(q) describe how the organization plans to continue to increase the state's minimum collection rates, minimum recycling rates, and minimum postconsumer-recycled-content rates after January 1, 2030, and January 1, 2035;	14.2 Transitioning Additional Covered Materials to the Minimum Recyclable List 12 Operations Plan: Postconsumer Recycled Content
(r) describe how the organization will verify minimum postconsumer-recycled-content rates and how postconsumer-recycled-content rates will be calculated using weight and other metrics, and describe any waivers from minimum postconsumer-recycled-content rates granted to a type or subcategory of covered materials and the criteria for evaluating such waivers, including food safety requirements, technological feasibility, or inadequate supply, and how often the waivers will be reviewed;	12 Operations Plan: Postconsumer Recycled Content

(s) describe how the organization will provide producers with the opportunity to purchase postconsumer-recycled materials from processors at market prices if the producer is interested in obtaining recycled feedstock to achieve minimum postconsumer-recycled-content rates;	12 Operations Plan: Postconsumer Recycled Content 12.4 Increase PCR Rates and Provide Opportunity for Producers to Purchase PCR Materials
(t) describe how the organization will reduce or offset the producer responsibility dues for any producer or group of producers that fund or operate a collection program that: (I) covers a specific type of covered material that is not processed by materials recovery facilities; and (II) has recycling rates that meet or exceed the minimum recycling rate target set forth in the plan proposal pursuant to subsection (4)(p) of this section;	Offsetting Producer Dues for Programs

(u) describe how the organization will work with service providers to: (I) utilize and expand on existing recycling services and infrastructure and existing education and outreach programs; (II) reduce contamination of covered materials delivered to materials recovery facilities and compost facilities by: (A) requiring each materials recovery facility and compost facility participating in the program to report annually to the organization on contamination levels at each facility; and (B) providing funding or other assistance to compost facilities to reduce the costs of managing or increase the effectiveness of efforts to manage contamination and to process and recover compostable packaging materials; (III) invest in new or upgraded recycling infrastructure; (IV) propose an approach to measure and report on the use of reusable and refillable covered materials and establish goals and approaches for increasing the use of reusable and refillable covered materials; (V) mitigate the impacts of covered materials on other materials and equipment at sorting and processing facilities; (VI) invest in market development for covered materials in the state; and (VII) increase the recycling of collected covered materials	(u) 6 Operations Plan: Service Provider Reimbursement (u)(I) Establishing Post-Collection Service Agreements (u)(II) 9 Operations Plan: Compostable Packaging (u)(III) 14.3 Investing in Recycling Infrastructure and End Markets (u)(IV) 11 Operations Plan: Reuse and Refill (u)(VI) 13.2 End Market Development
(v) describe how the organization will work with and incentivize producers to reduce the packaging of products using covered materials through product design changes, the development or expansion of systems for reusable packaging, and product innovation;	16 Eco-Modulation Approach 14.4 Working with Producers to Reduce the Packaging of Products Using Covered Materials
(w) describe how the program will prioritize the use of end markets that return postconsumer recycled materials to their original product type;	12 Operations Plan: Postconsumer Recycled Content
(x) describe how the organization will evaluate and monitor the use of responsible end markets through methods such as processor contracts or financial incentives;	13 Operations Plan: Responsible End Markets
(y) describe how the organization will implement the education and outreach program set forth in section 25-17-707;	8 Operations Plan: Education and Outreach

(z) describe a process and timeline, beginning no later than 2028, to expand recycling services to applicable non-residential covered entities, as identified in the needs assessment pursuant to subsection (3)(a)(v) of this section; and	14.1 Expand Recycling Services to Applicable Non-Residential Covered Entities
(aa) include any additional information required by the department.	See Plan Appendix

1 Summary

This Program Plan (the Program) outlines the approach, goals, and operational framework for implementing Colorado's Extended Producer Responsibility (EPR) system under House Bill 22-1355 Producer Responsibility Program for Statewide Recycling Act (the Act). This legislation seeks to transform the state's recycling landscape by making producers responsible for the end-of-life management of their packaging materials and paper products. By outlining an approach to expand and enhance Colorado's recycling system, this Program aligns with statewide environmental, economic, and public health objectives.

The Program will operate under the stewardship of Circular Action Alliance Colorado LLC (CAA Colorado), a nonprofit Producer Responsibility Organization (PRO). CAA Colorado's mission is to help producers comply with EPR laws, deliver harmonized best-in-class services and work with governments, businesses and communities to reduce waste and increase recycling. CAA Colorado is the entity through which producers of covered materials will fund recycling services, support innovation in materials management, and ensure collected materials are directed to responsible end markets to be recycled into new products – including new packaging. CAA Colorado has developed a comprehensive approach to managing and administering Colorado's Program for covered paper and packaging materials. CAA Colorado's team includes a wide range of recycling sector and policy experts with extensive knowledge in EPR planning, including implementation, operations, education and outreach, producer services, and material-costing and due setting methodologies. CAA Colorado has engaged with the broader recycling community in Colorado to formulate this five-year Program Plan. This engagement has included consultation with the Colorado Department of Public Health and Environment (CDPHE), the Colorado Producer Responsibility Advisory Board (advisory board), and producers.

Program Plan Goals

CAA Colorado's goal is to support the successful implementation of the Act in collaboration with CDPHE, consultation with the advisory board, and in cooperation with producers registered with CAA Colorado, recycling service providers, local governments and all other interested parties. Through the implementation of this Program, CAA Colorado intends to help develop the circular economy in Colorado by:

- Establishing a centralized statewide system for managing recycling, minimizing waste, and increasing the recycling and reuse of covered materials.

- Utilizing the dues paid by producers of covered materials to provide a sustainable funding mechanism for recycling services and infrastructure across all of Colorado.

- Standardizing a list of readily recyclable materials.

- Leveraging existing recycling, reuse and compost[1] systems and infrastructure.

- Promoting new infrastructure where necessary.

- Expanding access to recycling services for all covered entities, particularly in underserved areas.

- Promoting increased use of PCR in products and packaging.

- Incentivizing packaging design to reduce negative environmental, social, and health impacts.

- Implementing a statewide education and outreach campaign to improve outcomes.

- Supporting innovations in recycling infrastructure and end markets.

The key measurable outcome at the end of the five-year duration of this Program are to increase recycling rates from an estimated 25 percent (2022 baseline measurement) to 41 percent in 2030, improve processing of compostable covered materials, and ensure continuous improvement related to reuse and refill. The goals are further detailed in the *Program Plan Goals* Chapter, along with key objectives, metrics, and measures to help chart progress and determine success. Table 2 presents the program Collection and Recycling rate mid point goals for 2030 and 2035.

Table 2: Program Collection and Recycling Rate Goals

Rate Type	Baseline (2022)	2030	2035
Collection Rate	29%	44%	59%
Recycling Rate	25%	41%	55%

Operations Plan

As Colorado's designated PRO, CAA Colorado oversees the development and implementation of the Program and works to achieve the Act's objectives. The Program hinges on collaboration with producers, local governments, service providers, community organizations, and Colorado residents. Additionally, CDPHE ensures regulatory compliance while the advisory board provides ongoing input.

The operations plan details the specific approach that CAA Colorado expects to employ to catalyze a range of recycling system expansions and improvements to achieve the collection and recycling rate targets and overall Program goals. Detailed plans and recommendations cover topics including:

- Recycling services approach

- Reimbursement of recycling service costs

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[1] Refers to the definition of "composting" included under 6 CCR 1007-2 Part 1, section 1.2.

- System expansion

- Education and outreach

- Reuse and refill systems

- Post-consumer recycled content

- Responsible end markets (REM)

- Compostable packaging

Figure 1 presents a diagram of material and funding flows under the future EPR Program, which broadly relate to aspects of the operations plan.

Figure 1: EPR System Flow Chart

End Markets

Responsible End Markets. REM verification, data tracking, audits, and investments. Provide an opportunity for producers to purchase recycled content materials and increase PCR rates.

Compost Facilities

Provide funding and assistance to reduce contamination and increase recovery of covered materials, no reimbursement of services.

Post Collection

Transfer Stations and MRFs. Services are reimbursed through service agreements. Investment to expand capacity, materials, and efficiency.

CAA to reimburse 100% net service costs, including expansion.

Collection

Drop-offs and Curbside. Services provided by local governments, non-profits, and private business. Services are reimbursed through service agreements.

Producers

Producers are required to meet compliance obligations, report data, and fully fund the recycling services and infrastructure in Colorado.

Financing

Obligated producers pay dues on covered materials. Dues vary by type of covered material, whether the material is readily recyclable, and net recycling service costs for each material. Dues are eco-modulated to incentivize or discourage targeted outcomes.

Covered Entities

Single family, multi-family and non-residential. Recycling services are provided to covered entities at no cost. Access expanded to all residents by 2030. Non-residential is phased in beginning in 2028.

Education and Outreach

Statewide education and outreach campaign. Includes CAA efforts, funding to local governments, and through service agreements with collectors.

Key: Provides System Funding   Receives System Funding

Providing Recycling Services

The goal of CAA Colorado's service approach is to implement statewide recycling practices for covered materials that meets or exceeds Colorado's convenience standard, which is defined as: the collection of readily recyclable materials provided in a manner that is as convenient as the collection of solid waste in the geographic area in which the covered entity is located. Meeting this goal requires an approach that outlines the management of covered materials. Central to this effort is establishing the Minimum Recyclables List (MRL) for covered materials that are readily recyclable and the Additional Materials List (AML) for covered materials collected in specific geographic areas that are managed through methods like curbside service or drop-off centers. Covered materials not on the MRL or AML will not be collected for recycling under this Program. The figure below displays the definitions and relationships between the material lists.

Figure 2: Covered Materials, MRL, and AML

Covered Materials. Materials that are included in the EPR Program as stipulated in the Producer Responsibility Act. Includes packaging material and paper products, except as specified in section 703(13)(b) of the Act.

Minimum Recyclable List. The uniform, statewide list of covered materials based on whether the covered material is readily recyclable, including the availability of recycling services, recycling collection and processing infrastructure, and recycling end markets for covered materials.

Additional Materials List. Covered materials not on the Minimum Recyclables List that may be collected in different geographic areas through curbside services, drop-off centers, or other means.

Colorado's recycling infrastructure varies widely across regions and requires tailored investments and solutions. CAA Colorado will take a phased, adaptive approach to meet the 2030 collection and recycling rate goals that considers regional needs, existing and required infrastructure, and gaps in service. CAA Colorado will strive to increase access to recycling services, with access defined as the availability of recycling services, including collection infrastructure. CAA Colorado will work with service providers, local governments, tribal nations and other interested parties to build on established urban, suburban, and rural recycling systems and infrastructure to increase

access and service, while rural and underserved areas will see investments to build or improve access, service, and infrastructure.

Service agreements with public, private, and nonprofit service providers to collect or process MRL and AML materials will include reimbursing the net costs of recycling services, ensuring that covered entities incur no direct charges. In 2026, initial service agreements for reimbursement of residential services will begin, using existing infrastructure in areas where there is recycling access. Progress towards access in rural and underserved areas will also begin in 2026, but it might take several years for infrastructure investment to materialize into recycling services for all covered entities. Incentives for compost facilities to process certified compostable packaging and reduce contamination will also help processors recover covered materials. In 2028, CAA Colorado will begin to reimburse recycling services for schools, progressively expanding reimbursement for other non-residential covered entities by 2030. These collective investments in access and service are expected to achieve the 2035 goals.

Reimbursement of Recycling Service Costs

The Program sets the framework for reimbursing service providers for 100 percent of the eligible net costs associated with recycling covered materials, while also ensuring a cost-efficient program. This framework is designed to promote fair and open practices, equitable service access, system enhancement and efficiency, and to achieve statewide recycling goals. The reimbursement rates for participating service providers are calculated using objective cost formulas established by CAA Colorado and developed through consultation with interest holders and the advisory board. Additional incentives factored into the overall framework will help drive collection and service expansion, realize efficiencies, encourage continuous improvement, spur innovation, and ensure materials are marketed to REM. Service providers will be reimbursed by CAA Colorado and thus will no longer charge their customers for recycling services.

The Program establishes a reimbursement system for collection and post-collection services. Public, private, and nonprofit service providers can participate and be eligible for reimbursement by meeting minimum standards for quality, safety, and compliance, including compliance with all federal, state, and local worker safety laws. Tribal entities with jurisdiction in Colorado may opt into the program. The reimbursement system will be implemented through a three-step process:

1. Request for Reimbursement (RFR): Service providers respond to RFRs detailing qualifications and compliance with standards.

2. Qualification: Providers meeting minimum requirements are deemed eligible to have a service agreement with CAA Colorado.

3. Service Agreements: Negotiated agreements establish reimbursement terms, performance metrics, and data reporting requirements.

Reimbursement of drop-off and curbside collection costs will cover costs such as a capital costs, base-level education and outreach, operational costs, reasonable profit margin, and eligible

administrative expenses. Any applicable recycling service income a provider might receive (e.g. grants, commodity sales) will influence how a reimbursement is calculated. Three approaches will be taken for reimbursement based on current collection models:

1. Open Market: Subscription-based service providers reimbursed using zone pricing or actual costs.

2. Local Government Collection: Collection services performed by local governments reimbursed based on the local government's cost of providing recycling service.

3. Contracted Collection: Collection service performed by a service provider contracted by a local government jurisdiction and reimbursed based on the local government's cost of providing recycling service.

Post-collection services include transfer, sorting, and preparation of materials for REM. CAA Colorado's goal is to establish service agreements with Material Recovery Facilities (MRFs) and recycling transfer facilities to cover the net post-collection costs. To avoid double payment, participating collectors will not be charged processing or tipping fees (the charge levied upon a given quantity of material received at a processing facility) at participating post-collection facilities. The reimbursement formula for post-collection processing at MRFs includes:

- Processing costs per ton of material

- Commodity sales revenue

- Incentives related to improvements such as efficiency, yield, and material marketing

To ensure accurate reimbursements and program performance, CAA Colorado will require regular reporting of material quantities, service costs, material disposition, and other data. CAA Colorado will perform data audits to verify claims and isolate costs for covered materials. Service providers will use CAA Colorado's service provider portal for streamlined claims submission and tracking. Service agreements will also cover the process for regular material composition evaluation to enable contamination tracking and annual data reporting.

System Expansion

The Program aims to improve recycling service accessibility, expand services to underserved communities, and invest in infrastructure to meet Colorado's 2030 collection and recycling targets. By leveraging performance-based service agreements and targeted funding mechanisms, the Program will support sustainable growth while prioritizing flexibility and innovation in recycling operations.

Non-Residential Entities

The Program aims to expand recycling services to non-residential covered entities beginning in 2028. The proposed timing to implement collection services for non-residential covered entities is described in the table below. This will be further informed by waste composition studies and

collaboration with service providers to design tailored collection and reimbursement systems. CAA Colorado will also work to address the complexities of servicing mixed-use collection routes and identifying residential-like materials in non-residential waste streams.

Table 3: Non-Residential Expansion Timeline

Non-Residential Covered Entity	Proposed Year to Begin Reimbursement
Schools	2028
Local and State Government Buildings	Prior to 2030
Public Places	Prior to 2030
Hospitality Locations	2030
Small Businesses[2]	2030

Expanding the Minimum Recyclable List

The material expansion plan aims to transition materials from the AML to the MRL by removing barriers to recyclability through investments in MRFs, drop-off improvements, and end market development. Piloting new collection methods and engaging in eco-modulation will also encourage producers to adopt recyclable packaging designs. Additionally, education and outreach campaigns will raise public awareness and support the adoption of any supplemental collection systems needed for the recovery of AML materials.

System Investment

The Program outlines an investment approach for Colorado's recycling infrastructure. By using service agreements to drive operational improvements and system expansion CAA Colorado will leverage existing infrastructure and encourage innovative, cost-effective solutions. A System Development Fund will also be established to directly address capital gaps for high-risk or low-volume areas, including funding for rural infrastructure, processing, and local end market development. The scale of the System Development Fund will be dependent on the RFR process, the processors and collectors that choose to participate in the program and their specific needs, ongoing assessment of market gaps, and annual evaluations of progress toward program goals. By collaborating with organizations that provide industry-specific capital, CAA Colorado aims to enhance access to external investment funding while fostering local economic growth.

Implementing this system expansion will build a resilient and efficient recycling ecosystem that meets Colorado's environmental goals while delivering economic and social benefits. Through

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[2] Small business is defined as an individual business at a physical business location that has less than the total annual gross sales as adjusted annually by the Consumer Price Index as specified in Section 1.8.2 of CDPHE's Regulations Pertaining to Solid Waste Sites and Facilities. As of 2025 the annual gross sales limit is less than $5,632,843 in realized gross total global revenue, not including on-premises alcohol sales, during the prior calendar year.

continuous monitoring and adaptation, CAA Colorado will ensure that the system evolves to meet future challenges and opportunities.

Education and Outreach

Education and outreach activities aim to educate, increase awareness and change behaviors to increase recycling, composting, and reuse/refill activities, reduce contamination, enhance public confidence in Colorado's recycling systems, and reduce litter. The education and outreach program must address Colorado's diverse regional, cultural, and demographic needs while overcoming barriers such as low public awareness, and inconsistencies in service messaging. Success will be measured through participation rates, material recovery and quality metrics, and community engagement feedback. Working closely with local governments, service providers, and communities, CAA Colorado's education and outreach activities will focus on:

- Expanding access to recycling services through increased Program awareness.

- Achieving minimum collection and recycling rate targets.

- Encouraging reuse and refilling of packaging.

- Enhancing public participation in recycling while reducing litter.

- Building trust in the proper management of recyclable materials.

CAA Colorado plans to deliver clear, consistent, and culturally appropriate messaging to audiences, including all covered entities, producers, local governments, and service providers. Statewide campaigns to promote recycling awareness and service availability will be complimented with customized community-level efforts, including direct mailers, public events, and local collaborations. CAA Colorado will collaborate with community organizations to adapt materials to local services and cultural contexts. During the first two years, messaging will focus on residential recycling as services become available. It will also include messaging around compostable products, reuse, and refill, as well as messaging designed to encourage recycling related behaviors. As reimbursement of services to non-residential entities expands, education and outreach efforts will include these additional covered entities.

Compostable Packaging

CAA Colorado will work with compost facilities to improve their ability to more effectively process compostable packaging and reduce contamination related to non-compostable covered materials. Insufficient public awareness, and limited composting infrastructure are current obstacles to the processing of compostable packaging. The Program's approach is to enhance the recovery and processing of certified compostable packaging while reducing contamination. This effort aligns with broader statewide goals of sustainable waste management and reduction of landfill dependency.

The Program aims to achieve key objectives through targeted initiatives such as direct funding to compost facilities, targeted education and outreach programs, and inbound material composition

tracking, which would include contamination. Financial incentives will be provided to participating compost facilities to encourage the acceptance and proper handling of covered compostable packaging, while potential grants through the System Development Fund may be considered for further system improvements. Targeted investments will provide resources, and facility upgrades while ensuring reporting compliance. Facilities currently processing smaller quantities will receive proportionally higher funding per ton, and financial caps will prevent disproportionate allocation of resources. Performance metrics and periodic audits will ensure transparency and accountability.

Outreach campaigns will educate residents and businesses on proper disposal methods to reduce contamination and increase recovery rates. Additionally, systematic and statewide material characterization studies will enable data-driven decision making and continuous improvement.

Through collaboration, robust monitoring, and an adaptive methodology, CAA Colorado's compostable packaging approach anticipates increased public awareness and engagement, enhanced system efficiency, and reductions in contamination levels. These outcomes will pave the way for more sustainable and economical recovery of certified compostable packaging.

Reuse and Refill Systems

CAA Colorado's producer members often serve the entire US market and so CAA Colorado aims to work with and assist its producer members with both meeting their state-by-state obligations, and implementing a cohesive, efficient, and informed national approach. CAA Colorado understands that adoption of reuse/refill will require addressing multiple barriers but also sees opportunities to use its obligations in EPR-regulated jurisdictions to work with its members and the reuse/refill community on identifying barriers and finding solutions, piloting approaches to test their veracity, and working towards broader adoption.

The Program will promote reusable/refillable packaging systems to decrease reliance on single use covered materials. With a focus on economic incentives, public education, and collaboration, the Program seeks to address existing barriers and aims to establish a measurable and sustainable culture of reuse/refill systems.

Current challenges include the limited availability of reuse/refill infrastructure to support collection, cleaning, and redeployment of reusables. To overcome these obstacles, CAA Colorado proposes targeted actions: incentivizing producers through eco-modulation, promoting reporting mechanisms, and fostering public awareness of the benefits of reusable and refillable packaging. CAA Colorado will also establish a Community of Practice, consisting of parties that want to make its packaging more sustainable by studying and implementing reusable/refillable options, and that encourage consumers to participate. The Community of Practice would provide guidance and tools for producers to enable them to transition effectively to reusable/refillable systems.

CAA Colorado will establish metrics to track progress and reporting protocols to gauge the Program's effectiveness and drive continuous improvement. CAA Colorado will set a baseline for reuse and refill activities and track year-over-year improvements. Following the establishment of a baseline and an accurate data reporting and verification protocol, CAA Colorado will establish a

specific target as opposed to a continuous improvement metric. This metric and target will be included in the five-year Program update. The desired outcome is a measurable reduction in single-use packaging waste, bolstered by an inclusive approach that engages businesses, governments, and communities.

Post-Consumer Recycled Content

CAA Colorado recognizes the importance of returning post-consumer recycled content (PCR) materials to producers for use in new packaging. Service agreement incentives, collaboration with post collection processors and end markets, and data tracking and sharing, will together provide producers with the opportunity to procure PCR materials that meet their requirements. By fostering a market for recycled materials, the Program's PCR plan aims to stabilize material flows, encourage innovation in packaging design, and reduce environmental impacts.

This Program's PCR approach sets goals to increase PCR use, establish minimum content targets for various materials, and incentivize market participation. The approach also includes a pathway to provide producers improved access to PCR materials through service agreements, incentives, and data sharing. Collectively, this approach aims to drive demand for materials containing PCR, reduce reliance on virgin resources, and foster a more sustainable packaging industry.

The Program seeks to address both the limited availability of certain PCR materials as secondary feedstock, technical barriers to using PCR in specific applications such as food-contact packaging, thus achieving consistent policy alignment with other PCR jurisdictions, and reducing the administrative burdens on producers. To overcome these challenges, CAA Colorado will establish material-specific PCR targets, create mechanisms for waivers when technical or economic feasibility is constrained, and collaborate with interested parties to refine this approach over time.

Table 4 below outlines the Program's progressive PCR targets for key material categories by 2030 which were developed through discussions with interested parties including industry associations. The proposed PCR targets are not individual producer targets.

Table 4: PCR Targets by Material Class

PCR Reporting Class	Estimated 2024 PCR Content Level[3]	Proposed 2030 Target
Rigid plastic packaging	9–11%	20%
Flexible plastic packaging	1% or less	5%
Paper and paper packaging	30 – 40%[4]	40%
Metal packaging	30 – 40%[5]	40%
Glass packaging	15 – 25%[6]	30%

CAA Colorado will grant eco-modulation incentives for producers exceeding eco-modulation targets and support improvements to recycling infrastructure. This includes a robust verification framework that uses third-party certifications and self-attestation models to balance accountability with ease of reporting. Through these actions, CAA Colorado aims to reduce barriers to circularity and encourage the use of PCR.

Responsible End Markets

The Act defines responsible end markets (REM) as, "a materials market in which the recycling of materials or the disposal of contaminants is conducted in a way that: (a) benefits the environment; and (b) minimizes risks to public health and worker health and safety." CAA Colorado will help to ensure that covered materials recovered under the Program are processed through responsible and sustainable pathways while relying on participating MRFs to market the commodities. CAA Colorado will also support the growth of local REM to help drive the state's circular economy.

Key REM challenges include geographic and logistical barriers, recycling material market volatility, contamination in recycled materials, and limited local recycled material processing capacity. The Program addresses issues such as market risk and insufficient long-term purchasing agreements, while emphasizing transparency, regulatory compliance, and collaboration with local, regional, and national interest holders to bolster REM.

The Program's objectives include establishing REM verification standards, prioritizing the growth of local or regional REM, and incentivizing materials that return to their original product types. CAA Colorado will implement a phased approach, initially developing a robust REM verification

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[3] CAA Colorado estimates based on published reports and discussions with trade organizations and producers.

[4] AF&PA reports average recycled content of 45% in 2023, report does not consider overseas product and yield loss.

[5] Based on data from Aluminum Association and RRS Steel Can Recycled Content White Paper, CAA Colorado's assessment of current recycled content rates are 40%. However, packaging, represent a small proportion of the overall recycled content, limiting CAA Colorado's capacity to drive the market, and producers' capacity to meet the target for packaging. Note that pre- and post-consumer content is not well tracked.

[6] CAA Colorado market research indicates that the PCR content for North American glass containers may be between 22% to 28%.

framework, followed by expanding market capacity and enhancing material quality to meet REM specifications. A key component is harmonizing efforts with EPR programs in other states to reduce administrative burdens and ensure regulatory consistency.

By fostering collaborations, reducing market barriers, and investing in innovative end market solutions, CAA Colorado aims to create a sustainable and resilient recycling infrastructure. This initiative not only enhances material recovery but also drives economic growth through job creation and local investment.

Program Budget and Producer Dues

CAA Colorado has forecasted a five-year budget for the Program that is based on reimbursing existing recycling services and expanding the recycling system to achieve improved recycling and accessibility performance as well as conducting statewide education and outreach, meeting outcomes related to reuse and refill, and improving recovery of compostable packaging. The program budget describes how producer dues will cover the key system cost components and non-material management program costs. The process of setting dues through covered materials ensures that all producers contribute fairly to program operating costs based on material type and volume, recycling complexity, and market impact. By integrating Circular Action Alliance's national dues-setting methodology with Colorado-specific elements, the Program seeks to provide sustainable funding while supporting the operational efficiency of Colorado's recycling system.

Program Budget

The five-year budget incorporates material management costs (e.g., collection, transfer, processing), non-material management expenses (e.g., education and outreach, program administration), and reserves. Preliminary cost estimates, derived from the Needs Assessment, are presented as a range of costs and provide a framework for Program sustainability while allowing for adjustments based on future data.

Producer Dues

Dues will be calculated annually using CAA Colorado's methodology that integrates material costing indices accounting for Colorado's material-specific management costs, commodity revenues, and non-material expenses. The producer dues are based on the net recycling services costs for each covered material in the state and vary by the type of covered material and if it is readily recyclable. CAA Colorado's dues-setting methodology aligns with national standards to ease administrative burdens for producers operating in multiple states. The process ensures fairness, clarity, and transparency, with annual updates and consultations to address changes in market dynamics and Program needs.

Adjustments to Base Dues

CAA Colorado will integrate mechanisms to adjust dues, reduce administrative burdens and promote sustainable packaging practices, including:

- In-Kind Advertising: Newspaper, magazine, and periodical publishers that are primary sources for news and current events could contribute CAA Colorado education and outreach content in lieu of dues, aligning outreach with Program goals.

- Flat Rates and De Minimis Levels: Simplified dues structures offered to low volume producers to ensure fair contribution towards paying dues without administrative burden of detailed reporting complexity.

- Eco-Modulation: The eco-modulation factors will be used to adjust producer base dues with the aim of influencing producer product or packaging design choices. Eco-modulation factors will be applied after the base dues have been calculated. The incentives and maluses will be applied using eco-modulation factors that increase or decrease base dues as required by law.

Management and Compliance

The Program outlines compliance mechanisms for producers on reporting, dues payment, and material management. Circular Action Alliance will establish secure online portals for producer registration, dues payment, supply data submission, and other related data. Producers will report annually, with their dues reflecting material-specific management costs, commodity revenues, and eco-modulation factors. Circular Action Alliance will conduct annual reviews of producer compliance, data accuracy, and dues adjustments based on actual Program costs and performance metrics. Audits and reporting will promote accountability among all Program participants and enable continuous improvement. Enforcement of producer compliance is the responsibility of CDPHE.

CAA Colorado will create a data management system to track material flows across the value chain, from collection to end markets, to enable monitoring, facilitate audits, and ensure that collected materials are responsibly processed. The robust data tracking and reporting structure will provide essential insights into Program performance and inform adjustments to meet recycling targets.

2 Program Plan Goals

House Bill 22-1355, [The Producer Responsibility Program for Statewide Recycling Act](#)[7] (the Act), was signed into law on June 3rd, 2022. This legislation enables Colorado's first EPR system for packaging materials and paper products by requiring companies that supply these covered materials to work together, as part of an independent, non-profit organization called a PRO, to fund and operate a statewide recycling system. The Act sets requirements for the PRO's structure, as well as the development and implementation of a program plan.

Circular Action Alliance met this call to action by bringing together producers of materials covered by the Act to form a non-profit PRO for Colorado. On May 1, 2023, CDPHE appointed Circular Action Alliance as the PRO responsible for implementing statewide recycling program in Colorado for packaging and paper products.

The overarching goal of CAA Colorado for this Program is to successfully implement a statewide recycling program that achieves the Act's specific producer responsibility program declarations, which are outlined in quotes in the table below, followed by CAA Colorado's approach.

Table 5: Producer Responsibility Program Declarations, CRS 25-17-702(g)

Statutory Declaration	CAA Colorado Approach
(VI) "Be managed by an independent nonprofit organization that consults with an advisory board of recycling experts overseen by the department;" and (I) "Establish a centralized system for managing recycling in the state that is funded through annual producer responsibility dues paid by the producers of covered materials"	Circular Action Alliance is the state's designated PRO that supports producers meeting their obligations under the Act. CAA Colorado's services include setting and collecting producers' dues to cover the costs of the recycling system and contracting with service providers to cover the costs of recycling, enhance services and expand the recycling system.
(II) "Establish a clear and uniform statewide list of readily recyclable materials."	This Program describes the MRL developed through consultation with interested parties. The MRL is a uniform list of recyclable materials that will be collected across the state in a manner that is as convenient as the collection of solid waste by covered entities and provides an economy of scale for recycling services.

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[7] https://leg.colorado.gov/sites/default/files/2022a_1355_signed.pdf

(III) "Provide a sustainable funding mechanism for recycling services and recycling infrastructure across all areas of Colorado."	CAA Colorado is developing a comprehensive methodology for determining how much funding producers are required to contribute to the system. Factors such as system costs, material class, volume of product sold into the state, the net recycling service costs, cost to manage materials, and commodity revenues are considered when setting producer dues.
(IV) "Promote the increased use of readily recyclable materials in new products and packaging."	CAA Colorado encourages producers to increase the use of recycled materials in packaging. The program sets targets for minimum inclusion of PCR, which is the amount of PCR materials used in the production of covered materials, including targets to achieve by 2030. The Program proposes collaborating with recycling markets to assist producers' efforts to access PCR materials. The plan also includes eco-modulation incentives to continue to encourage increased levels of PCR materials.
(V) "Encourage producers to design packaging and use covered materials to prevent or minimize their negative environmental, social, economic, and health impacts."	In addition to requiring the use of postconsumer recycled materials, CAA Colorado encourages producers to design packaging and use covered materials through dues-setting, eco-modulation, and reuse and refill systems. The dues-setting process incentivizes the use of readily recyclable materials and producers will pay lower dues when switching packaging to these covered materials. Eco-modulation adjusts producer dues by granting incentives and charging maluses for certain factors.

(VII) "Invest in recycling end market development and innovations that could attract new businesses to Colorado and create a more resilient domestic supply chain."	The producers of covered materials are investing in Colorado's economic development by expanding access to recycling services. This investment will have greater returns to the state with development of local end markets that can transform covered materials into secondary feedstock or products. CAA Colorado plans to further collaborate with local economic development groups to develop Colorado-based end markets, and reserve capital to help catalyze these opportunities. This would truly be a circular economy, one where Colorado reduces, reuses/refills, or recycles packaging materials as long as possible.
(VIII) "Leverage existing recycling systems and infrastructure by working with both public and private service providers."	Previous investment by public, private, and non-profit entities has been made into Colorado's recycling system, and further investment is required to meet the solid waste convenience standards, increase access to recycling services, and meet the recycling goals of this Program. This is accomplished through CAA Colorado's plan to provide recycling services that reimburses service providers for existing services and then expands these relationships to provide recycling services in areas with limited access or infrastructure.

2.1 Collaborating Towards Successful EPR

Successful EPR in Colorado relies on collaboration with, and contributions from, numerous parties including producers, CDPHE, local governments and tribal nations, service providers, community and educational organizations, REM, and compost facilities.

Producers

Producers are central to the Program, required to register, report materials supplied by category, and fully fund the recycling system through dues. They also assist by encouraging other producers to register with Circular Action Alliance, and by innovating packaging design.

Producers provide data on PCR content and apply eco-modulation incentives and recycling guidance in packaging design. Active participation is expected through Circular Action Alliance's work groups and collaborative forums.

CDPHE and the Advisory Board

CDPHE oversees the Program, managing the advisory board, approving Program plans, and informing producers about requirements, exemptions, and consequences for non-compliance. It enforces Program integrity through compliance monitoring of producers and evaluates CAA Colorado's processes. CDPHE reviews data and conducts rulemaking including eco-modulation bonuses and benchmarks.

The advisory board includes representatives from cities, counties, non–Front Range governments, service providers, non–profits, packaging manufacturers, as well as trade associations, retailers, environmental groups, CDPHE, and CAA Colorado. The advisory board reviews this Program and consults with CAA Colorado on amendments to the Program. Additionally, the Board will recommend that CDPHE's executive director approve or reject the proposed Program and amendments. The advisory board's membership can be found on CDPHE's Producer Responsibility advisory board website[8]. In collaboration with CAA Colorado and the advisory board, CDPHE drives continuous improvement to ensure the Program's success and alignment with state policies.

Local Governments and Tribal Nations

Local governments and tribal nations that opt into the Program help to ensure it addresses community priorities. They engage in service agreements with CAA Colorado for recycling services and tailor outreach efforts to underserved communities.

These entities regularly provide data to CAA Colorado to support reimbursement claims and promote educational objectives. Local government led initiatives such as licensing programs or organized collection systems are encouraged to expand recycling access. Their collaboration fosters growth and continuous improvement of the Program.

Service Providers

Service Providers deliver recycling services under agreements with CAA Colorado, offering no cost services to covered entities and receiving reimbursement for 100 percent of eligible recycling service costs. They use reimbursements to expand access, improve efficiency, and incorporate new materials into recycling streams.

Service providers contribute to education and outreach activities, tailoring materials to local contexts and ensuring alignment with Program goals. They drive innovation through pilot programs, improve material quality, send materials to REM, and collaborate with CAA Colorado and interested parties to enhance outcomes.

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[8] https://cdphe.colorado.gov/hm/epr-advisory-board

Community-Based Organizations and Educational Institutions

Community-based organizations amplify education and outreach efforts, tailoring materials to resonate with target audiences. They support inclusivity by engaging trusted leaders at educational institutions and in underserved communities to promote Program participation.

These entities play a role in refining and strengthening the Program by collaborating with CAA Colorado through service contracts to address end market barriers, enhance recycling systems, and advance Program sustainability.

Responsible End Markets

REM ensure materials are managed sustainably through participation in CAA Colorado's verification process. Where applicable, they embrace incentives to accept more materials and enhance quality standards, ensuring recycled products meet specifications. REM also play a key role in providing producers with the opportunity to purchase recycled materials for achieving PCR targets in new packaging and paper products.

By addressing market barriers and collaborating on development projects, these markets contribute to the long-term sustainability and success of Colorado's Program.

Compost Facility Operators

Compost facility operators support the Program by recovering compostable packaging, monitoring non-compostable covered material contamination rates, and working with CAA Colorado to further reduce contamination and improve the recovery of compostable packaging.

They conduct education and outreach following CAA Colorado guidelines and collaborate to enhance system efficiency and advance composting processes. Their efforts are funded through service agreements and contribute to the Program's long-term integrity and sustainability.

2.2 Collection and Recycling Rate Targets

One of the most important steps in developing this Program was understanding where to start. The Needs Assessment provided this starting point as it evaluated Colorado's existing recycling infrastructure and services, including curbside and drop-off collection, hauling, sorting at MRFs, and final processing.

The Needs Assessment identified opportunities for improvement, proposed a standardized list of materials that could be collected and recycled, and developed three scenarios for increasing Colorado's collection and recycling rates by 2030 and 2035.

In this Program, the collection and recycling rate are defined as the following:

- **Collection rate**: The weight of covered materials collected under the program in a calendar year divided by the weight of covered materials used for products sold or distributed by producers within or into the state in the same calendar year, expressed as a percentage.

- **Recycling rate**: The weight of covered materials recycled[9] under the program in a calendar year divided by the weight of covered materials used for products sold or distributed by producers within or into the state in the same calendar year, expressed as a percentage.

The Colorado Legislature's Joint Budget Committee (JBC) approved[10] implementation of the Needs Assessment's medium scenario which provides outcomes and key metrics for objectives that meet the Act's goals, notably the collection and recycling rate targets.

This includes collection convenience standards, the option for weekly residential collection in the Front Range and bi-weekly in the other regions, expansion of drop-off sites, and medium/high investments in MRFs and compost facilities. Table 6 details the mid points of the target ranges.

Table 6: Collected and Recycling Rate Targets Mid Points Under the Joint Budget Committee-Approved Scenario

Material	Baseline (2022) Collection Rate %	Baseline (2022) Recycling Rate %	Medium (2030) Collection Rate %	Medium (2030) Recycling Rate %	Medium (2035) Collection Rate %	Medium (2035) Recycling Rate %
Paper	24	22	43	40	61	58
Cardboard	49	45	66	62	78	74
Glass	40	30	56	50	67	61
Metals	40	37	59	55	77	73
Rigid Plastics	16	14	26	24	44	42
Flexible Plastics	<1	<1	2.5	2.5	3.5	3.5
Total	29	25	44	41	59	55

The medium scenario projects an increase in the recycling rates for paper and packaging from 25 percent in 2022 to 41 percent in 2030 and 55 percent in 2035, as detailed in Table 7.

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[9] Recycling means the reprocessing, by means of a manufacturing process, of a used material into a product or a secondary raw material. Recycling does not include: (i) energy recovery or energy generation by means of combustion; (ii) use as a fuel; (iii) use as alternative daily cover as defined in section 30-20-1402 (1); or (iv) landfill disposal of discarded covered materials.
[10] https://cdphe.colorado.gov/press-release/colorado-announces-approved-scenario-to-increase-recycling-rates-statewide

Table 7: Program Collection and Recycling Rate Goals

Rate Type	Baseline (2022)	2030	2035
Collection Rate %	29	44	59
Recycling Rate %	25	41	55

2.3 Program Goals and Metrics

This chapter provides detail on how the following goals of the Act will be achieved:

1. Provide sustainable funding for recycling covered materials throughout Colorado.
2. Build an equitable statewide system for collecting, sorting, and consolidating covered materials.
3. Grow a circular economy that encourages residential and non-residential covered entities to participate, reduces negative impacts from end-of-life management of covered materials, and creates new business in Colorado.

Goal 1: Sustainable Funding for Recycling Covered Materials Throughout Colorado

The Program aims to establish reliable and sustainable funding through producer dues to support the recycling of covered materials throughout Colorado.

Table 8: Program Goal 1, Outcomes and Metrics

Program Goal	Outcomes/Indications of Success	Key Metrics
Design and implement a producer reporting program and dues structures that meets the Act's objectives.	• Producer reporting invoicing, compliance, and informational platforms established that are clear, effective, and efficient for producers to use • The annual base dues schedule adequately supports program goals and objectives • A financial reserve with a minimum of three months' operating costs and a maximum of six months' operating costs • Eco-modulation incentive and malus factors to adjust producer dues	• Producer compliance metrics • Annual third-party financial audit of the program including a detailed list of the program's costs and revenues from the producer responsibility dues • Status and adequacy of the reserve funds • Eco-modulation incentives granted • Eco-modulation maluses applied

Goal 2: Statewide Collection and Recycling System

The Program seeks to ensure that recycling access meets or exceeds Colorado's convenience standard.

Table 9: Program Goal 2, Outcomes and Metrics

Program Goal	Outcomes/Indications of Success	Key Metrics
Recycling access is to be provided in a manner that is as convenient as the collection of solid waste in the geographic area in which the covered entity is located.	• Recycling collection is provided in a manner that is as convenient as the collection of solid waste • Recycling access is offered for covered non-residential entities • Access to recycling services is provided equitably to covered entities in all regions of the state	• Number of single family residences, MFUs, and covered non-residential entities with recycling collection service by year: access, participation, collection method, location
Establish a clear and uniform statewide list of readily recyclable materials.	• Defined MRL that must be collected in a manner that is as convenient as the collection of solid waste • Defined AML that may be collected through curbside services, drop-off centers, or other means • A process for transitioning material from AML to MRL • Support existing glass drop-off and collection services and collect glass through single stream and new drop-off collection • Collect flexible plastics through drop-off locations, retail locations, and supplemental collection	• Annual updates to the MRL conducted in consultation with the advisory board • MRL and AML access, transition of materials from AML to MRL, flexible plastic collection, and glass collection by locations and dates

Leverage existing recycling programs and infrastructure by working with both public and private service providers.	• Reimbursement service agreements with collection and post-collection service providers through open, competitive, and fair procurement practices • Strong labor standards, worker safety practices, and environmentally sound management practices, enforced through service agreement standards • Participating service providers have reliable, long-term reimbursement agreements that can be used to obtain capital for infrastructure improvements and service expansion • Participating compost facilities have funding that can be used for contamination control and increased recovery	• Number of participating collection and post-collection service providers and coverage throughout the state • Signed service agreements with minimum worker health and safety standards, environmentally sound management practices, annual data tracking from participating service providers • Efficiency metrics for collection and post-collection of MRL and AML materials before and after equipment investment • Number of compost facilities participating in the program and amount of compost produced from source separated organics • Contamination rates associated with compost facilities
Drive efficiency in recycling collection to manage Program costs.	• Collection is provided free to the consumer via program service agreements which include standards and incentives for efficiency • Collection of hard-to-recycle packaging is provided through a system of drop-off centers and events • Reduced contamination in incoming streams to MRFs and compost facilities	• Collection measured by service agreements unit costs, per household yields, and material characterization audits • Number of single stream and multi-stream collection programs

Program Objectives	Outcomes/Indications of Success	Key Metrics
Achieve recycling rates approved by the Joint Budget Committee in April 2024.	• Meet or exceed collection and recycling rate targets approved under the JBC–approved medium scenario	• Annual collection and recycling rates as percentage of covered materials supplied to the Colorado market and compared to 2030 medium scenario

Goal 3: Advancing a Circular Economy

This goal focuses on fostering increased participation, reducing environmental impacts, and stimulating new business growth in Colorado.

Table 10: Program Goal 3, Outcomes and Metrics

Program Objectives	Outcomes/Indications of Success	Key Metrics
Statewide participation and awareness of recycling, recycling services, and the EPR program.	• Covered entities already participating in recycling programs increase capture rates • Covered entities that are not yet participating in recycling begin participating • Improved source separation and reduced contamination levels • Implementation of statewide education and outreach campaign through direct CAA Colorado activities, service providers, and local collaborators	• Participation, diversion, and contamination rates on a geographic and material-specific basis; before and after campaigns • A suite of metrics specific to the types of marketing, education, and engagement campaigns

Encourage innovations in packaging design, reuse and refill, and recycling through eco-modulation.	• Reduction in the amount of single-use packaging used in covered materials • Increased recyclability or commodity value of covered materials • Increased postconsumer recycled material in packaging • Increased use of reuse and refill packaging design • Increased recycling/refill rates • Decreased use in designs, practices, and covered materials that create barriers to recycling, reusing/refilling, or composting covered materials	• Producer-reported data for eco-modulation incentives and penalties • Eco-modulation incentives provided • Eco-modulation maluses applied
Increase the use of reusable and refillable covered materials.	• Establish a system to measure and report on the use of reusable and refillable covered materials • Increased use of reuse/refill systems for covered materials and decrease in single-use packaging	• Annual tracking of abated single use packaging
Ensure post-consumer recycled covered material can be used in the same or similar applications, reducing the need for virgin resources.	• Producer targets are set by PCR category, that will drive market demand for secondary materials over time • A system to verify PCR rates by covered material that ensures transparency • Incentivize recyclers and producers to create and use more PCR suitable for packaging • Producers have an opportunity to purchase postconsumer-recycled materials from processors at market prices	• Minimum PCR targets for producers to be achieved by 2030 and 2035 • Material gap studies to identify materials for which meeting PCR targets may be challenging • Verifying PCR through third-party verification schemes and the use of different chain of custody models • Increases in PCR supply and demand

Ensure that covered materials have robust end markets that demand the quality and supply generated.	• Covered materials are valued by REM and service providers have access to these markets • Improved end markets for prioritized AML materials • New business growth in Colorado using recycled covered materials	• Collection and recycling data to identify materials below target thresholds • Bale contamination data to inform of the quality of commodities delivered to markets • Performance results from investments and incentives to REM. • Direct and indirect job creation in Colorado is associated with end market use of covered materials
Ensure that materials collected and processed for recycling in Colorado are consistently delivered to REM.	• System of identifying REM and tracking material flows established in collaboration with service providers and markets • MRF, drop-off, and other collection material streams directed to REM • System established to continually monitor REM non-compliance and to address and correct issues that arise regarding REM	• Percentage of recycled material going to REM • Annual publication of verified REM by type • Number of non-compliance issues and chain of custody anomalies identified, corrected, and brought into compliance • Number of challenges identified by end markets and assistance deployed to work through those problems
Reduce loss of materials to landfill and greenhouse gas footprint of covered materials.	• State of Colorado's Solid Waste Management plan shows trending decreases in tons of covered materials to landfill • Greenhouse gas equivalent of recycling covered materials increases	• Tons of covered materials collected and recycled • EPA waste reduction model results

3 About Circular Action Alliance

3.1 Description of the Organization

Circular Action Alliance is a U.S., nonprofit 501(c)(3) PRO established to support the implementation of EPR laws in multiple states for paper, packaging, and foodservice ware. The organization was founded by leading U.S. producers representing retail, food, beverage, and consumer packaged goods manufacturing. Circular Action Alliance's mission is to help producers comply with EPR laws, deliver harmonized best-in-class services and work with governments, businesses and communities to reduce waste and recycle more.

Circular Action Alliance's Founding Members are, as of submission of this final program plan, are Amazon; The Campbell's Company; The Coca-Cola Company; Colgate-Palmolive; Conagra Brands; Danone North America; Ferrero US; General Mills; Georgia-Pacific; IKEA Supply AG; Keurig Dr Pepper; The Kraft Heinz Company; L'Oréal USA; Mars, Incorporated; McDonald's USA, LLC; Mondelēz International; Nestlé USA; Niagara Bottling, LLC; PepsiCo, Inc.; Procter & Gamble; SC Johnson; Starbucks Corporation; Target; and Walmart.

Circular Action Alliance was incorporated as a nonprofit corporation in 2022 and is recognized by the Internal Revenue Service as tax exempt under Internal Revenue Code Section 501(c)(3). Circular Action Alliance has organized separate wholly owned nonprofit 501(c)(3) subsidiaries to serve as the representative stewardship organization for producers in each state that passes an EPR law. Circular Action Alliance Colorado LLC (CAA Colorado) was formed in 2024. Both Circular Action Alliance and CAA Colorado are nonprofit organizations exempt from taxation under Section 501(c)(3) of the Internal Revenue Code. Currently, Circular Action Alliance is the designated PRO for paper and packaging in Colorado, Oregon, California and Minnesota, and the organization provides producers with consistent EPR services across multiple states while developing and implementing EPR programs that:

- Meet state-specific regulatory requirements.
- Leverage established recycling systems and infrastructure.
- Advance the circular packaging through collaboration with local governments, service providers, and other entities in the recycling system.

Circular Action Alliance's National Board of Directors (the National Board) is made up of representatives of Founding Member companies, which represent a diversity of covered material supplied to the Colorado market.

The National Board has established a designated body known as the Colorado Board, to help oversee the submission of this Program, and to provide strategic oversight and guidance to CAA Colorado, subject to final approval and oversight by the National Board. The Colorado Board is comprised of a diverse range of producers including representatives of Circular Action Alliance's

Founding Members, representatives of other producers, and non-voting trade associations representing covered materials.

Circular Action Alliance's organizational structure is described in the *Circular Action Alliance Organizational Structure* Appendix. This includes the organization's executive leadership, and the national program operations team.

3.2 Producer Registration and Engagement

Circular Action Alliance has established a registration process for producers supplying covered materials into Colorado. On October 31, 2024, CAA Colorado submitted a list of the initial 1,594 registered producers to the CDPHE. This list is also publicly available on Circular Action Alliance's website https://circularaction.org/registration. Producers who missed the registration deadline must register with Circular Action Alliance, and producers who have not registered may be subject to CDPHE enforcement actions.

In support of the initial producer registration deadline and ongoing registration requirements, Circular Action Alliance conducted several initiatives to identify, connect, and educate potential producers about their obligation to register. To reach these businesses, Circular Action Alliance used a variety of education and outreach activities, including:

- Producer onboarding webinars

- Public Quarterly Updates

- Working Groups for registered producers

- Meetings with key trade associations

- Conferences and speaking events

- Social media campaigns

- Email newsletters

- A producer portal with comprehensive reference materials

- A dedicated Producer Services team available to address producer questions

Circular Action Alliance has created a Producer Resource Center[11] on its website providing producer registration, onboarding materials and reporting guidance - to support producers in preparing for their obligations. Registered producers participate in Circular Action Alliance-hosted monthly Producer Working Groups and webinars on reporting and regulatory topics that cover updates and highlight key upcoming producer requirements. Circular Action Alliance will continue to actively register producers and expand participation ahead of the Program implementation, including conducting information sessions with unregistered producers and trade association.

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[11] https://circularactionalliance.org/producer-resource-center

4 Consultation and Informing the Program Plan

> **Excerpt from the Act**
> 25-17-705 (4)(c) CAA Colorado Describe the manner in which the organization solicited and considered input from stakeholders and the advisory board in developing the plan proposal. The organization must provide a summary of any comments about the plan proposal from the advisory board and additional stakeholders and identify changes made to the plan proposal based on the comments.

The following chapter describes how CAA Colorado solicited and considered input from interested parties and the advisory board. The summary of comments and their impact on the Program are included in the *Summary of Consultation Comments Received and Changes Made to the Program* Appendix.

CAA Colorado gathered information from various sources to shape the Program, including:

- **Remote and In-Person Workshops**: Engaged a diverse group of recycling service providers, advocates, organizations, and other industry professionals from across Colorado and the nation.

- **CAA Colorado Needs Assessment**: Collected data through surveys and interviews from industry participants, as well as researched existing programs.

- **Public Feedback:** Solicited public feedback on the consultation materials through online surveys and presentations on key aspects of the Program.

- **Industry Research**: Conducted research on best practices in Colorado and across the U.S. Reviewed findings from relevant reports and needs assessments completed by other organizations. Conducted industry-specific assessments to explore topics such as contamination levels, processing availability, access, and investment needs.

- **Individual Meetings**: Met with Colorado communities, nonprofit service providers, recycling collectors, and MRFs to gather insights.

- **Producer Input**: Solicited feedback from producers through working group meetings and webinars.

- **Advisory Board Guidance**: Received recommendations and guidance from the advisory board.

- **CDPHE Discussions**: Held regular weekly meetings and have maintained an ongoing dialogue with CDPHE staff to identify issues, collaborate on solutions, and prepare for Program Plan submission.

- **EPR Program Plans**: Evaluated EPR Program Plans from other states, Canadian provinces, and European countries to establish best practices.

4.1 Public Input

CAA Colorado conducted consultations with a variety of interested parties, including producers, collectors, MRFs, end markets, compost facilities, municipalities, non-governmental organizations, trade associations, end markets, and the public.

CAA Colorado provided multiple venues for feedback, including webinars, subject-specific online and email questionnaires, and through advisory board meetings.

In total, ten formal consultation webinars were held from July to September 2024 (see table below). All interested parties were welcomed to participate in the scheduled consultations. Each consultation webinar covered a specific topic presented by CAA Colorado and included an interactive question and answer session with attendees.

Following each session, CAA Colorado shared a questionnaire with the participants, inviting their input on the session's topic for up to 30–days after the session. Those unable to attend were able to review the meeting materials posted on CAA Colorado's website and share input through the questionnaire. The *Summary of Consultation Comments Received and Changes Made to the Program* Appendix includes a summary of all comments received through the consultation process and their impact on the Program's development.

Table 11: Consultation Sessions

Consultation Webinar Topic	Date	Description	Attendees
Minimum Recyclable List, Minimum Collection Targets, and Recycling Rates	July 30, 2024	CAA Colorado presented the MRL, covered materials list, producer compliance, minimum recycling rates, and minimum collection rates in this session.	446
Education and Outreach Program	August 1, 2024	Recognizing that effective education and outreach is essential to the success of Colorado's Program, CAA Colorado shared its proposed education and outreach plan to solicit feedback on considerations and implementation approaches.	88

Producer Dues	August 6, 2024	CAA Colorado outlined producer definitions and qualifications, guiding principles, the framework methodology for dues-setting, reporting, timelines, and other considerations, to solicit feedback from potentially interested parties.	319
Compostable Products and Composting	August 13, 2024	CAA Colorado outlined requirements addressing compostables in the Program, discussed contamination, compostable packaging, and education and outreach specific to compostables.	185
Reimbursement Session 1 – Collectors	August 20, 2024	CAA Colorado outlined the statutory requirements, options and considerations for the reimbursement pathways, probe non-residential collection and multifamily housing, and methodology framework for collection reimbursement. This session specifically addressed reimbursement elements for collection services providers including private, public, nonprofit, curbside, and drop off.	110
Reimbursement Session 2 – Processors	August 27, 2024	CAA Colorado presented reimbursement considerations and frameworks for MRFs and composters.	108
Post-Consumer Recycled Content	September 5, 2024	CAA Colorado outlined methods to increase PCR content in packaging, a process to verify PCR content, and a method of securing end market feedstocks for interested producers and solicited feedback from interested parties.	262

Responsible End Markets	September 10, 2024	Colorado's Program is intended to build and support a circular economy. To that end, the Program Plan must include elements that prioritize responsible end markets. This session addressed considerations around REM and fostering and supporting a circular economy.	274
Eco-Modulation	September 12, 2024	CAA Colorado discussed the eco-modulation factors that incentivize innovations in packaging while discouraging other potentially detrimental packaging decisions, approaches being used elsewhere, reporting, package design incentivization, and other issues.	203
Building Circularity	September 17, 2024	CAA Colorado reviewed needed infrastructure investments to improve collection and recycling rates, closed loops by developing end markets, and filling gaps in transforming collected material into usable commodities in manufacturing. The session also solicited input on additional materials and the required plan elements around reusable and refillable covered materials.	151

Additional direct outreach was also undertaken with the following groups:

Advisory Board: As a key advisor, the advisory board was kept up to date on the next steps in the EPR process and the engagement schedule with the different interested parties. CAA Colorado participated in 19 advisory board and work group sessions prior to the plan proposal submission. Following the plan proposal submission, CAA Colorado participated in nine additional advisory board and work group sessions to collect feedback and comments on the plan proposal.

Colorado Municipalities: CAA Colorado held in-person meetings at the Colorado Municipal League Conference, and hosted a booth and provided a printed QR code and link for municipalities to provide their contact information to receive webinar invites, as well as a fact sheet CAA Colorado also attended a meeting hosted by Recycle Colorado in November 2024 to consult with municipalities that operate under open market subscription systems.

Colorado's Recycling Community: CAA Colorado has been deeply engaged with Colorado's recycling community, particularly through Recycle Colorado. Through its members, Recycle

Colorado has provided substantial expertise and input into the development of the Program. In June 2024 with CDPHE, CAA Colorado attended and presented at the Recycle Colorado Summit to introduce CAA Colorado's Executive Director and provide an update on the Program. In September, CAA Colorado hosted a workshop at Recycle Colorado's Annual Meeting to gather input on developing the Program. CAA Colorado also met with the National Waste and Recycling Association (NWRA) and hosted a workshop at the Solid Waste Association of North America (SWANA) fall conference in September 2024. CAA Colorado participated in a meeting with compost facilities and compostable packaging producers in November 2024 to discuss compostable packaging approaches. In addition to organized group meetings, CAA Colorado has had more than 50 individual meetings with Colorado service providers, local governments, and community organizations.

Colorado Producers: To help producers comply with registration requirements, CAA Colorado conducted several webinars to educate the business community on EPR for paper and packaging. CAA Colorado presented to industry groups including:

- Colorado Chamber of Commerce
- Colorado Chamber Alliance
- Colorado Beverage Association
- Colorado Restaurant Association

Targeted Group Meetings: Additional conversations with specific entities or organizations were offered after each of the consultation sessions to dive deeper into certain subjects. These meetings were scheduled throughout the year and will continue an ongoing basis throughout Program implementation.

National Producer Meetings: CAA Colorado has hosted webinars, presented at workshops and events, and engaged with trade organizations to gather valuable input and feedback for developing the Program. Some of the events and consultations include:

- Monthly Producer Working Group meetings for all registered producers
- Multi-party meetings with national producers
- Producer on-boarding workshops

Trade Organizations: Meetings with trade organizations including but not limited to: AMERIPEN, Distilled Spirits Council, Association of Plastic Recyclers, The Toy Association, Independent Beauty Association, American Cleaning Institute, Council for Responsible Nutrition, American Beverage Association, NWRA, SWANA, American Bakers Association, Household and Commercial Products Association, Consumer Technology Association, Agricultural Container Recycling Council, American Chemistry Council, Fenestration and Glazing Industry Alliance, and American Apparel and Footwear Association.

Events: CAA Colorado attended or presented at more than 50 events to promote producer registration, solicit feedback, increase engagement, and share information. Examples of events

include: Sustainability in Packaging, Plastics Recycling Conference, Independent Beauty Association Spring Conference, AMERIPEN Annual Summit, Foodservice Packaging Institute annual meeting, GreenBiz Circularity 2024, Waste Expo, International Safety Equipment Association Meeting, Sustainable Brands Conference, Product Stewardship Institute Forum, Specialty Papers US Conference, Association of Plastic Recycler, NPE2024: The Plastics Show, Resource Recycling Conference, Pack Expo International, and the American Forest and Paper Association Forum.

4.2 Role of the Advisory Board

The advisory board had several roles in the development of this Program including advising CAA Colorado throughout the Needs Assessment process, reviewing the Needs Assessment report, and hosting Advisory Board and technical work sessions that were open to the members of the public. Past Board and technical work session meeting materials and recordings can be found on CDPHE's Producer Responsibility advisory board website[12].

CAA Colorado has participated in over 44 Advisory Board meetings and technical work sessions to guide the development of this Program and the Needs Assessment. Advisory Board meeting materials are publicly posted on CDPHE's website[13].

This amended plan proposal addresses the Advisory Board's review of the plan proposal in accordance with section 25-17-705 (5) of the Act. The *Summary of Consultation Comments Received and Changes Made to the Program* Appendix includes a summary of all comments received through the consultation process and their impact on the Program's development. The appendix includes the Advisory Board's amendment requests, additional comments, and the identification of any changes made to the plan proposal.

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[12] https://cdphe.colorado.gov/hm/epr-advisory-board
[13] https://cdphe.colorado.gov/hm/past-epr-meeting-materials

5 Operations Plan: Recycling Services Approach

This chapter describes activities and approaches for increasing the diversion of recyclable materials from disposal to support progress toward the Act's objectives. Important tasks for CAA Colorado include establishing service agreements for reimbursement, implementing the education and outreach program, providing funding for compost facilities, and others key activities required to meet Program goals.

5.1 Summary of CAA Colorado Approach

CAA Colorado will provide recycling services through service agreements with cities, consolidated cities and counties, towns, counties, collectors, MRFs, non-profits, and other service providers. The goal is to establish statewide recycling programs that meet convenience standards and are supported by an education and outreach program that is funded by producers. The guiding principles for service provision include fairness, leveraging existing infrastructure and supporting new infrastructure where needed, maintaining a competitive marketplace, driving efficiency, ensuring transparency, and aligning with environmental objectives.

The service approach will be phased in over time, starting with reimbursing existing services and progressing towards full implementation by 2030.

Key implementation activities include:

- Reimbursing service providers for existing recycling services (e.g., curbside and drop-off collection).

- Expanding services in communities and regions lacking recycling access, particularly in rural areas.

- Improving system performance and expanding the range of minimum recyclable materials.

- Supporting compost facilities to reduce contamination and improving the processing of compostable packaging.

- Encouraging innovation in collection and processing in Colorado's recycling systems.

CAA Colorado will track data and publish annual reports to document progress toward the approved recycling rate target for paper and packaging. By 2030, the aim is to achieve residential recycling collection as convenient as the collection of solid waste for the entire state, ensure recycling services are offered to all non-residential covered entities, and increase Colorado's recycling rate. As described in the Needs Assessment, the Program is anticipated to collect approximately 570,000 tons of materials and recycle approximately 530,000 tons of materials annually by 2030.

5.2 Providing Recycling Services

Excerpt from the Act

25-17-705 (i) establish a funding mechanism that; (I) does not exceed the direct and indirect costs of implementing the program, including the costs of; (A) providing recycling services under the program through contracts with service providers or reimbursement of recycling services costs under the reimbursement rates proposed pursuant to subsection (4)(j) of this section.

This section describes the approach to the provision of recycling services for covered materials to covered entities to meet the Program goals. CAA Colorado's primary tool for service provision will be through the establishment of service agreements with cities, consolidated cities and counties, towns, counties, collectors, MRFs, non-profits, and other service providers to provide recycling services to covered entities. Recycling services will be supported through the statewide education and outreach campaign and targeted system funding.

Goals

The goal of CAA Colorado's service approach is to design and implement statewide recycling programs for covered materials that meet or exceed the convenience standards throughout the state.

Implementation

Advancing Colorado's recycling system from its current model to one in which producers are fully responsible for funding the system requires a careful, phased approach. The current recycling system has a great deal of variability in terms of effectiveness, metrics and approach to covered materials and contracts. To successfully achieve Program aims while adhering to the guiding principles, the service approach will be phased in over time. The appropriate analogy is that of a dial rather than an on/off switch.

CAA Colorado will begin implementing the Program within six months of its approval and phase in new agreements and services to achieve the 2030 collection and recycling rate goals. Below is CAA Colorado's general approach to achieving the 2030 collection and recycling rate goals, with activities occurring concurrently:

- **Reimburse Service Costs for Existing Services:** CAA Colorado will establish recycling service agreements with eligible collectors currently providing local government collection, contracted collection, and those operating in open market subscription areas. These agreements will reimburse participating service providers for recycling services related to the collection of covered materials from covered entities, inclusive of drop-off and curbside collection. Reimbursement for these services from CAA Colorado, means covered entities will no longer be charged for these services. Additionally, CAA Colorado will form service agreements with MRFs and transfer facilities to cover the net post-collection service costs.

- **Increase Participation Where Access and Infrastructure Exist:** In many parts of Colorado, particularly metropolitan areas, service providers are already capable of supplying recycling services, and there is sufficient infrastructure to process MRL materials. CAA Colorado's service agreements and education and outreach efforts will aim to increase covered entity participation in these areas and ensure service providers meet the convenience standard.

- **Invest in Systems Where Access and Infrastructure Are Lacking:** As described in the Needs Assessment, certain regions of Colorado (especially outside the Front Range and in rural areas) face limitations in available collection and processing services. To achieve Program goals, CAA Colorado will collaborate with service providers, including local governments, through service agreements to invest in the expansion of collection and infrastructure, ensuring that covered entities can access no cost recycling services by 2030. This will involve identifying investment needs and establishing service agreements with pathways for addressing gaps, enabling scaled investments to meet the 2030 collection and recycling rate goals.

- **Improve System Performance and Add New Materials:** CAA Colorado will work with service providers and producers to continually evaluate and enhance the recycling system's performance, including:

  o Identifying material market gaps, investing in REM and providing incentives for market development to create a circular economy for covered materials.

  o Improving infrastructure and REM opportunities to allow for expansion in the scope of materials that are included on the MRL.

  o Working with service providers to continually invest in and improve the recycling system, including enhanced sorting rates, reduced contamination, improved material quality, and increased efficiency and innovation in collection and processing.

  o Funding and providing other assistance to compost facilities to improve processing abilities of compostable covered materials and reduce contamination of non-compostable covered materials delivered to compost facilities.

- **Establish Service Agreements:** CAA Colorado will utilize an open, fair, and competitive approach to establish service agreements for collection and post collection services. Service agreements will be established through a three-step RFR process, which will vary slightly based on the different service types:

  o Local Government RFR: For local government provided services, including contracted collection services and education and outreach activities delivered by the local government. Local governments can include towns, cities, and counties. Tribal nations wishing to opt into the EPR program will be invited to participate through this process.

- o Open Market RFR: For private and non-profit service providers operating in open market subscription areas.

- o Post-collection RFR: For transfer stations and material recovery facilities managing covered materials from covered entities.

Following initial RFR periods in 2026, the RFR process will be continually open to ensure that qualified service providers have an opportunity to participate in the EPR program. The RFR process is described in detail in Chapter 6 of the Program.

- **Develop Tools for Communities Considering Organized Collection:** CAA Colorado recognizes the potential efficiencies that can be gained through organized collection systems at the community level. This approach includes the potential for municipalities and counties to consider licensing requirements to expand access to covered entities as well as municipal contracting. Organized collection schemes can reduce the transactional costs for all parties which reduces overall system costs. Organized collection may also result in more efficient collection routes, improved environmental outcomes, reduced wear and tear on surface streets, improved health and safety, and improved data collection and reporting at the municipal or county level. CAA Colorado's service approach will include the development of model language for municipalities and counties interested in transitioning to more organized collection systems. The language will facilitate municipal-led procurement and create a more seamless claims and data reporting process that will reduce administrative burden for service providers and CAA Colorado.

5.3 Service Approach Timeline

Figure 3 outlines the timeline for providing services through service agreements, as well as the timeline for statewide education and outreach services and compost facility funding. Please note that some flexibility has been accounted for in the timelines. Additional details on reimbursements, education and outreach, investments, and other related activities are included in dedicated sections of the Program.

Figure 3: Service Approach Timeline

SERVICE	2025	2026	2027	2028	2029	2030
A. Local gov't collection – universal service / access						
B. Local gov't contracted collection – universal service / access						
C. Processor (MRF, Transfer) agreements						
D. Open market – universal service / infrastructure						
E. Open market – access to service / infrastructure						
F. Local gov't collection – limited / no recycling service						
G. Local gov't contract collection – limited / no recycling service						
H. Open market – limited / no recycling services						
I. Education and outreach						
J. Non-residential (Schools, State / Local Government Buildings)						
K. Non-residential (Public places)						
L. Non-residential (Hospitality, Small Business)						
M. Compost facility funding						

Figure 3 Key

	Initiation and Planning	Phase needed to prepare for implementation. May include preparation and release of RFR negotiations for service agreements, investment or incentive planning, and other program initiation related activities.
	Implementation	Phase required to implement the service approach. CAA Colorado expects that some service agreements will be signed at the beginning of the implementation period, while others will take additional time. The length of the bar is generally indicative of the potential level of complexity in the implementation process. For example, item '*G– Local Government Contract Collection with Limited/no Recycling*' has a longer implementation lead time as CAA Colorado may need to wait until existing contracts expire prior to adding recycling services in the contracted local government. Likewise, other activities with long implementation periods are expected to require long lead times for infrastructure to be built, trucks or collection carts to be delivered, or other transformational changes. CAA Colorado does not plan on signing any service agreements prior to final plan approval by CDPHE.
	On-Going Monitoring and Improvements	Following the initial implementation period, CAA Colorado will monitor performance and identify areas for continuous improvement. Additionally, service agreements are not static, meaning that as additional service providers offer additional services in Colorado, as communities change the way services are provided, or existing service providers expand services to other parts of the state, existing and new agreements will evolve.

Descriptions of each service element illustrated in Figure 3 are detailed below.

A. **Local Government Collection with Universal Service[14] or Access:** Defined as service agreements for collection services that are provided directly by local government where recycling is universally provided to all residences or readily available and offered to all residences upon request. In these locations, significant investments for collection infrastructure are not needed to meet the convenience standard.

Service agreements with local governments will be established through the Local Government RFR process. Towns, cities, counties, and tribes that currently, or plan to, provide recycling services (including education and outreach) to covered entities, are required to respond to the RFR to become eligible for reimbursements. Following the initial RFR period and the establishment of service agreements, the RFR process will be conducted on a rolling basis to accommodate system changes and ensure that all local governments that want to participate in the program reimbursements are able to do so.

B. **Contracted Collection with Universal Service or Access:** Defined as service agreements for collection where local governments contract a collection service provider to deliver service and recycling is universally provided to all residences (opt-out) or readily available to all residences upon request (opt-in).

Similar to local government provided collection, service agreements with local governments that contract for services will be established through the Local Government RFR process. These locations do not require significant investment for new carts or trucks to meet the convenience standard. Decisions around contracting for the provision of services to residents will remain with the local government.

C. **Post-Collection Agreements:** Defined as service agreements with public, private, non-profit MRFs and transfer facilities that want to participate in the Program.

The Post-Collection RFR process will lead to service agreements for processing that start in 2026, with a rolling process to establish additional post-collection agreements in future years. Post-collection service agreements will include language to upgrade processing capacity and to allow for more covered materials to be recycled, funding for system expansion will be provided by CAA Colorado primarily through reimbursement.

D. **Open Markets with Universal Service or Infrastructure:** Defined as open market zones in which service providers already have collection infrastructure (e.g. equipment, trucks, or additional infrastructure) to provide services to covered entities. May include large Multifamily Units (MFUs) and Homeowner Associations (HOAs).

Service agreements will be established through the Open Market RFR process. CAA Colorado will reimburse directly to collector based on zone pricing and will allow for an audited process to establish the actual costs for different services where needed. Zones will initially be established

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[14] Universal Service means a recycling program in which recycling service is required for all applicable covered entities.

based on a third-party analysis of factors that impact collection including, but not limited to; density, service types, distance to consolidation point(s), infrastructure, geographic features, and others. Where investments are needed, CAA Colorado service agreements will cover the costs through the reimbursement agreement terms.

E.   Open Market with Access to Some Service or Infrastructure: Defined as open market zones for which service providers may require time to purchase new equipment to provide services to all eligible covered entities. May include large MFUs and HOAs.

Service agreements will be established through the Open Market RFR process. Generally, there is capacity to process materials in these areas; however, some investment may also be required to ensure capacity for MRL materials through MRF reimbursements, purchase and deliver carts, or to purchase new collection vehicles. Agreement duration and terms will provide service providers with reimbursement for required investments. Investments in required infrastructure may result in a longer implementation lead time.

F.   Local Government Collection with Limited or No Recycling Service: Defined as collection services provided directly by local governments; however, recycling services are limited to a small portion of the community via an added fee, opt-in, or are not currently provided. These locations will require investment for equipment to achieve the convenience standard.

Service agreements will be established through the Community RFR process and will include mechanisms to reimburse for needed equipment. In some limited cases, CAA Colorado may also utilize grants to speed implementation. Some areas may also require investment in post-collection processing through transfer station or MRF reimbursement, to ensure there is capacity to consolidate and process MRL materials. Service agreements may require a ramp-up period, in which only a portion of the community is reimbursed at the outset, and services are expanded over time as new equipment is added. Should current collection and processing service providers be unwilling or unable to expand to meet convenience standards, CAA Colorado may conduct direct procurements through an RFP process to identify additional service providers that are willing to offer access to services.

G.   Local Government Contracted Collection with Limited or No Recycling Service: Defined as local governments contracted with a collection service provider to deliver service; however, recycling services are limited to a small portion or no portion of the community.

Service agreements for reimbursement will be established through the Community RFR process. In these communities, the local governments must choose to either amend their existing service contracts or wait for existing contracts to expire and complete a new municipally led procurement process. Once available, recycling services provided to eligible covered entities will be reimbursed by CAA Colorado. These areas require a longer implementation timeline, as lead time will be dependent upon existing municipal contracts. These areas may also require investment in post-collection processing to ensure there is capacity to process MRL materials, which would extend the lead time. Should current collection and processing service providers be unwilling or unable to

expand to meet equivalency standards, CAA Colorado may conduct direct procurements through an RFP process to identify additional service providers that are willing to offer access to services.

H.   Open Market with Limited or No Access to Services: Defined as open market zones in which service providers may not have collection infrastructure or access to transfer or processing facilities capable of processing covered materials from covered entities. Includes large MFUs and HOAs.

Service agreements will be established through the Open Market RFR process. Service providers operating in these areas will require time to secure new equipment to provide services. Service agreement duration and terms will offer service providers with a process for reimbursement for required investments.   Additionally, investment may be required to ensure capacity for MRL materials through post-collection reimbursements agreements. Due to the required investments for these areas, a long implementation lead time may be needed. As a result, CAA Colorado will begin working with service providers in these regions as soon as possible to allow enough lead time.

I.   Education and Outreach: Defined as statewide efforts led directly by CAA Colorado, payments to local governments, and reimbursements to service providers.

Statewide education and outreach will be critical to communicating with producers, local governments, service providers, customers, and other entities that are required or elect to participate in the Program. This effort will be ongoing and integral in achieving the service approach. Communities wishing to provide education and outreach directly to their residents will be required to enter into service agreements with CAA Colorado through the Community RFR process. Additional information on this approach is included in the *Operations Plan: Education and Outreach* Chapter.

J. K. and L. Non-Residential Collection: Eligibility, reimbursement pathways, and objective cost formulas for non-residential covered entities will be developed through the phased process described in the System Expansion Chapter.

Starting in 2028, CAA Colorado will begin to implement reimbursement for covered non-residential entities. CAA Colorado expects that schools, state, and local government buildings to be the first non-residential entities that will be eligible for recycling services. Service agreements established through the Community RFR process and subsequent reimbursement will be provided directly to either school districts, local, and state governments or to their contracted service providers. In 2030 or sooner, CAA Colorado plans to reimburse eligible recycling services for hospitality and small business. These service agreements will be established through the Open Market RFR.

M.   Compost Facility Funding: Defined as establishing contracts with eligible compost facilities.

CAA Colorado will provide direct funding to participating compost facilities to increase the recovery of certified compostable packaging and reduce non-compostable covered material contamination. CAA Colorado will offer a per-ton or per-cubic yard processing incentive to facilities that currently accept, and process covered compostable packaging. CAA Colorado may

engage with facilities who are willing to commit to developing a plan to accept and process compostable packaging.

6 Operations Plan: Service Provider Reimbursement

> **Excerpt from the Act**
>
> 25-17-705 (4)(g) Establish recycling practices that: (II) Use open, competitive, and fair procurement practices when entering into contracts with service providers, and, when entering into contracts with private service providers, adopt a preference for service providers with strong labor standards and worker safety practices; (III) Ensure that any covered materials collected for recycling will be transferred to a responsible end market.
>
> 25-17-705 (4)(j) Include reimbursement rates for one hundred percent of the net recycling services costs of the recycling services provided by service providers under the program consistent with the requirements of section 25-17-706. The reimbursement rates must: (I) Be calculated using an objective cost formula or formulas; (II) Incorporate the relevant cost information identified by the needs assessment pursuant to subsection (3)(a)(III) of this section; (III) Be calculated on a per unit basis such as per ton, per household, or other unit of measurement; and (IV) Take into account: (A) Regional recycling services costs; (B) Population density; (C) The number and types of households served; (D) The collection method used; (E) The revenue generated from covered materials; (F) The amount of inbound contamination and other factors affecting the quality of covered materials; and (G) Other demographic factors identified in the needs assessment pursuant to subsection (3)(a)(III) of this section.
>
> 25-17-705 (4)(k) Describe the process to evaluate and revise the objective cost formulas as necessary and using documented costs. If the plan proposal includes more than one objective cost formula for recycling services, the plan proposal must describe the conditions under which each formula will be applied.
>
> 25-17-705 (4)(l) Include a schedule of reimbursement rates for service providers that elect to participate in the program and be reimbursed by the organization for providing recycling services for the program and describe a process for updating the schedule periodically and as necessary;
>
> 25-17-705 (4)(g) Establish recycling practices that: (IV) Use environmentally sound management practices;

This chapter details the framework for reimbursing collection and post-collection service providers for 100 percent of their eligible net recycling costs for covered materials from covered entities, based on the trash convenience standard. Reimbursement to service providers is aimed at increasing access to recycling, collection rates, recycling rates, and improved environmental outcomes.

Reimbursable recycling costs help to establish a sustainable funding mechanism for the Program and promote fair and open practices, equitable service access, and achieving statewide recycling goals. The reimbursement rates for service providers participating in the Program are calculated using objective cost formulas established by CAA Colorado and are informed by relevant cost information from the Needs Assessment. The cost formulas have been informed by the Needs

Assessment, through the consultation process, discussions with the Advisory Board, and additional research undertaken by CAA Colorado.

Additional incentives are included for achieving the Act's goals through expanding collection service, continuous improvement, innovation, and marketing material to REM. These incentives will also work to drive investment in post-collection and end market development and innovations that attract and build businesses and create a stronger and more resilient recycling sector and supply chain in Colorado.

While the reimbursement framework supports the Act's goals of increasing collection, recycling, and post-consumer content rates, it also addresses several core challenges, including:

- Collection Model Variability: Different waste collection models are used across the state – ranging from open markets to local government and organized collection – as well as having significant variabilities in both geography and household type. As the Program launches, different collection models must be accommodated, driving the need for multiple reimbursement cost formulas.

- State Law: The Act states that notwithstanding any law to the contrary, a private service provider is not required to provide recycling services under the Program. Likewise, local governments are not required to provide recycling services under the Program. However, service providers that choose to participate in the Program and receive reimbursement shall use funds for recycling services and will not charge customers for the provision of the services.

- Infrastructure and Cost Variability: Colorado's diverse topography and concentrated population density creates discrepancies in existing recycling systems and services. Economies of scale and lower costs can be realized in areas such as the Front Range, which has resulted in more robust recycling systems in these areas, but distance to infrastructure and high transportation costs haves restricted access in rural and mountain areas. The reimbursement model seeks to address the variability to provide access for covered entities in all areas of the state.

- Isolation of Recycling Specific Costs: Many service providers are currently unable to separate recycling costs from other waste management expenses.

- Market Dynamics: CAA Colorado must balance reimbursement and incentives for service providers, while maintaining open and competitive procurement practices and cost controls.

- Contamination Management: When new recycling services are introduced, such as multifamily and residential collection, contamination of collected material may increase.

CAA Colorado must ensure consistent, high-quality recyclable materials delivered to processing facilities.

The reimbursement approach is informed by the following general framework: service agreements are established in open, competitive, and fair manner, providing an equitable and transparent opportunity for any qualified service providers to participate in the Program; CAA Colorado will leverage existing infrastructure and services that can meet regulatory requirements, and improve and expand collection, processing, capture and marketing of covered materials, and engagement, while operating cost-effectively; CAA Colorado will engage any interested service providers to foster opportunities for local businesses to participate; conduct on-going evaluation of efficiency and cost effectiveness to continuously improve the performance of existing recycling programs, expand access, and to add new materials in a cost-effective manner. CAA's service strategy is designed to ensure that all covered entities in Colorado have access to services that meet the convenience standards, and that there is sufficient capacity to consolidate, transfer, and process collected covered materials in an efficient manner. CAA cannot guarantee that service agreements will be signed with all service providers. For example, if a service provider cannot meet the minimum service standards, CAA may elect not to enter into an agreement with the service provider.

Service agreements will include elements to ensure that: reimbursement payments for recycling services provided are based on accurate and transparent information; they provide the predictability and consistency service providers need to invest, innovate, and expand; and that reimbursement for recycling services will be dedicated to eligible recycling programs, and not duplicate funding provided through other programs or sources for the same service.

CAA Colorado will post standardized forms, claims submissions and other program documents, including related policy documents for each type of reimbursement program. The claims reimbursement process will be designed to be efficient for all parties, including clear and transparent information requirements and request forms, feedback systems, and submission instructions, utilizing accessible and plain language, instructions and source data requirements to support reimbursement requests. Where possible, the process will rely on online submissions for better accessibility. The reimbursement approach will include standardized review criteria to support prioritization and assessment of claims, a streamlined dispute resolution process, data confidentiality and security, and appropriate accountability mechanisms to track reimbursements and payments.

These programs will be supported by trained CAA Colorado program staff dedicated to answering service provider questions, offering support to service providers interested in participating, and guiding participants through administrative and claims processes. This process will include working with small and independent haulers and governments throughout the development and implementation phase to ensure they have the access and information needed to participate in the program.

6.1 Reimbursement Approach Summary

According to the Act, a service provider is defined as a public or private entity, excluding the PRO, that provides recycling services in Colorado. Recycling service costs encompass the expenses associated with recycling programs, including collection, transportation, sorting, and processing of covered materials, administration, capital improvements, public education on recycling, and disposal of non-recyclable materials. CAA Colorado will cover the net recycling service costs incurred by service providers based on the convenience standards and standard service levels.

Participation in the Program is not mandatory for service providers or local governments, and consumers will continue to have the option to contract directly with service providers for recycling services. Reimbursements will be issued to public, private, and non-profit service providers according to the terms of their service agreements. Providers that choose to enter into reimbursement agreements must submit program performance and financial data as part of the claims process, which will be used to calculate and verify payment amounts owed to each participating provider.

Service providers opting to participate must meet and maintain minimum service standards, follow environmentally sound practices, establish minimum labor standards and worker safety practices and ensure convenient and equitable access to recycling services for all readily recyclable materials on MRL at no cost to the covered entity. These requirements will be established and monitored through agreements with service providers. Where possible, CAA will look to provide a preference for strong labor standards and worker safety practices when collection, hauling and processing services are tendered. CAA Colorado will publish the names, locations, and hours of operation for participating collection service providers.

At the time of Program launch, reimbursement is focused on recycling services for residential covered entities including single family and multifamily residences. Starting in 2028, the Program extends reimbursements to schools, progressively expanding to other non-residential covered entities by 2030.

6.2 How Reimbursement Works

CAA Colorado's reimbursement framework is divided into two distinct types of services: collection and post-collection.

Collection refers to service providers collecting MRL and AML materials from covered entities through either drop-off, curbside, or supplemental collection and transporting those materials to transfer stations or processing facilities, including MRFs.

Post-Collection refers to processing and other services, including receiving MRL and AML materials from collection, consolidation and transport of materials from transfer facilities, and receiving, sorting, and preparing materials for market at a MRF, including contamination management.

Participating service providers and local governments that want to receive reimbursements for recycling service costs must enter into service agreements with CAA Colorado. Service agreements will include a Master Service Agreement (MSA) that establishes the standard terms and conditions of the relationship as well as statements of work that will cover specific services, reimbursement rates, and other details. These agreements will vary depending on both the type of service provided and how the services are delivered. Service providers with service agreements must submit program performance and financial data as part of the reimbursement process, which will be used to calculate and verify payment amounts owed to each participating provider.

Payments from CAA Colorado are for the collection of covered material from covered entities. CAA Colorado will not reimburse service providers to collect or recycle:

- Materials that are not covered materials as defined in the Program.

- Paper and packaging that is supplied from exempt entities as defined in the Act.

- Paper and packaging supplied by producers that are part of an approved program plan for covered materials other than CAA Colorado's Program.

- Covered materials that are not on MRL or AML.

- Covered materials that are too contaminated to be properly processed (i.e., collectors should not accept covered materials that exceed an agreed-upon contamination threshold).

Three-Step Reimbursement Process

CAA Colorado will use open, competitive, and fair procurement practices when establishing service agreements for reimbursement of collection and post-collection services. For all service types, the reimbursement system will be implemented through a three-step process detailed in the figure below.

Figure 4: Reimbursement Process Overview

Step 1: Request for Reimbursement (RFR) — Request for Reimbursement (RFR): Service providers respond to RFRs. The RFRs will detail services, qualifications, and compliance with standards.

Step 2: Qualification — Qualification: Providers meeting minimum requirements are deemed eligible for service agreements.

Step 3: Service Agreement — Service Agreements: Negotiated agreements establish reimbursement terms, performance metrics, and data reporting requirements.

To ensure accurate reimbursements and program performance, CAA Colorado will require regular reporting of services provided, material quantities collected and recycled, service costs, and other data. CAA Colorado will perform audits to verify claims and costs for recycling services. Service providers will use CAA Colorado's online service provider portal for streamlined claims submission and tracking. Service agreements will also cover the process for regular material composition evaluation to enable contamination tracking and annual data reporting.

Reimbursement Service Agreements – Collection

> **Excerpt from the Act**
>
> 25-17-705 (4)(g) Establish recycling practices that: (II) Use open, competitive, and fair procurement practices when entering contracts with service providers, and, when entering into contracts with private service providers, adopt a preference for service providers with strong labor standards and worker safety practices;
>
> 25-17-705 (4)(g) Establish recycling practices that: (IV) Use environmentally sound management practices;

Reimbursement of drop-off and curbside collection will cover service costs including operating costs including reasonable profit margin, eligible administrative expenses, base-level education and outreach, and capital costs, minus any applicable recycling service revenue (e.g. grants, commodity sales). The collection models that will be reimbursed include:

- **Open Market:** Most covered entities in Colorado have recycling services provided through an open market or subscription-based services. Under this type of model, recycling services are provided to individual households, MFUs, or businesses through competitive, private sector offerings. In Colorado, all MFUs with more than seven units and non-residential entities procure and pay for recycling services through the open market.

- **Local Government/Municipal Collection:** Local government collection services are offered directly by municipalities or local government and funded through user fees, property taxes, general funds, or a combination of these sources.

- **Contracted Collection:** Contracted collection involves local governments hiring private-sector service providers in an open, competitive and fair procurement process. Recycling costs are covered through direct billing, property taxes, general funds, or a mix of these options.

Table 12 presents the Needs Assessment findings on the prevalence of each service type in the state.

Table 12: Collection Scheme by Region and Total Percentages of Municipalities (2020)

Region	Open Market	Contract	Local Government
Front Range	60%	34%	6%
Mountains	74%	13%	13%
Eastern Plains	40%	23%	37%
Western Slope	40%	40%	20%
Statewide	**56%**	**27%**	**17%**

Municipal or Contracted Collection Service Agreement Process

For municipal and municipally contracted collection services, CAA Colorado will use the following process for establishing service agreements.

Local Government Request for Reimbursement: CAA Colorado will issue a Local Government RFR to all Colorado communities, including towns, cities, municipalities, counties, and tribes. The RFR will solicit the specific data needed to begin the reimbursement service agreement process. CAA Colorado will conduct public meetings with local government staff to promote and answer questions about the RFR process and service agreements. Information requested by CAA Colorado from local governments may include, but is not limited to:

- Description of recycling services, including collection frequency and accepted materials.

- Copies of contracted and/or subcontracted collection contracts.

- Any education and outreach activities and how the government anticipates collaboration with CAA Colorado.

- Recycling system cost data.

Qualification: All local governments that respond to the RFR and provide reimbursable services to covered entities, either directly or through contracted services, will be deemed conditionally qualified for entering into a service agreement with CAA Colorado. Local governments must respond to the initial RFR to be eligible to enter into service agreements. The initial qualification period will likely include a deadline for responses, after which point additional agreements would be phased in on a rolling basis.

Recycling drop-off sites may be eligible for reimbursement. Initially, reimbursement for existing drop-off sites will be evaluated primarily by whether they service covered residential entities that do not receive curbside collection. CAA Colorado's intention is to initially include the public drop-off sites that service residential covered entities without curbside service.

For public drop-offs sites that service covered residential entities with access to curbside service, CAA Colorado will evaluate eligibility for reimbursement based on several criteria. Criteria may include the ability to track residential and non-residential materials, the quantity and quality of materials accepted, the proportion of covered materials from covered entities, and the collection of other AML materials from that drop-off, as well as costs. CAA Colorado will make best efforts to include existing public drop-offs for reimbursement while reserving the right to ensure program efficiencies.

Service Agreement: Service agreements will include the details for reimbursement of local collection or contracted services and the frequency of reimbursements which will based on reporting requirements being met. CAA Colorado. Eligible costs for services are described in the local government collection cost formula section of this Chapter.

Open Market Collection Service Agreement Process

The Act prevents CAA Colorado from requiring a household to sign up for service with a preferred collector and requiring any collector to provide recycling services to their customers. However, the open market approach will ensure that households and other covered entities have access to recycling service as required by the law, if they choose to access it.

CAA Colorado will ensure the open market reimbursement approach is equitable for all service providers, including smaller and independently owned and operated collectors. CAA Colorado is committed to maintaining a competitive marketplace that engages all interested service providers and is mindful of its role in maintaining and growing opportunities for local businesses and environmental justice. Collection service providers may engage subcontractors to provide parts of the services with the goal of an effective and efficient collection program.

The approach for entering into service agreements will consist of the following steps:

1. Publication of Zone Pricing
2. Three step RFR process
   a) Open Market RFR
   b) Qualification
   c) Service Agreement

Publication of Zone Pricing[15]: CAA Colorado anticipates publishing zone pricing in early 2026. The zone prices will include CAA Colorado's proposed reimbursement rate, expressed as price per

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[15] Zones may encompass 1 to 3 communities or may include a larger region, depending on the local factors. For each zone, CAA Colorado will publish a zone price for recycling collection service. The per household zone price will be the

household per month for each zone. Zones will initially be established based on analysis completed by a third-party for CAA. The reimbursement rate will vary based on each zone's geography, population density, demographics, distances to processing facilities, predominant collection type, and other factors described later in this chapter. The zone prices will be reviewed on a regular basis to ensure that the pricing covers the net service costs.

Open Market Request for Reimbursement: Following zone pricing publication, CAA Colorado will issue the Open Market RFR that clearly defines the scope of services, minimum service standards, environmentally-sound practices, and the initial terms that will translate into future service agreements. CAA Colorado will provide clear specifications, including labor standards and minimum worker safety expectations. CAA Colorado will conduct public meetings to raise awareness and understanding of the goals and objectives for the service and/or region under consideration. Information requested of the service providers in the RFR may include:

- General description of recycling services provided.

- Zones currently serviced and zones of future interest.

- Collection type, and materials collected.

- Infrastructure owned by service providers, e.g. transfer facilities, drop-offs, MRFs.

- Number and types of entities serviced today, and capability for service expansion.

- Verification of ability to meet minimum service standards prior to entering into agreement.

- Acceptance of zone pricing, by zone, or an indication that there is a preference for actual costs pricing.

Qualification: Interested service providers will provide a confidential statement of qualifications that details their experience, capabilities, and service offerings. This data will be used to ensure they are able to meet CAA Colorado minimum service standards. CAA Colorado will provide feedback to those service providers not meeting minimum standards and clearly identify what is needed to achieve the standards. Collectors that missed or choose not to respond to the initial RFR will not be eligible to enter into service agreements during the initial negotiation period. However, once the initial agreements are established the RFR process will be continuously open.

Service Agreement: CAA Colorado will negotiate with qualified service providers (those that meet or commit to the minimum service standards by Program launch), for pricing for collection by zone pricing or actual cost.

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basis of recycling collection reimbursement. Zone prices are based on an objective cost formula and will include reasonable profits margins for collectors.

- Zone pricing: All service providers accepting a zone price will be invited to participate in streamlined negotiation for that zone. Negotiations will lead to final service agreement terms which may be added to the master service agreement as separate scopes of work. Reimbursement rates will be price per household based on the published zone price.

- Actual cost: Service providers that do not accept a zone price may choose to submit a detailed request for an actual cost reimbursement in one zone, multiple zones, or a portion of a zone. Negotiations for actual cost submissions will occur only after initial zone pricing agreements have been established. CAA Colorado will assess the actual cost reimbursement considering the current acceptance rate of other service providers in the zone. CAA Colorado will retain the right to negotiate competitive pricing, and requests will require verified recycling service cost data to establish the reimbursement rate. Reimbursement payments will be provided quarterly or monthly, based on the terms of service agreement and the accurate and timely submission of claims verification data.

If needed, CAA Colorado reserves the right to release a request for proposal and ask for service provider bids for zones where the zone pricing or actual cost reimbursement process does not result in service agreements capable of providing access to covered entities.

Collection Agreement Standards

Collector service agreements will include service standards and basic qualifications historically common to solid waste collectors and will clearly define the minimum requirements providers must meet on a continuous basis to receive payments. Agreements will also include specific requirements necessary for claims verification, environmentally sound practices, data tracking, and other terms intended to support both continued delivery and expansion of recycling services to covered entities. Participating collectors must meet and maintain compliance with the minimum service standards.

Listed in the table below are the types of minimum qualification standards that CAA Colorado will require through contract agreement terms, while reserving the right to update as needed.

Table 13: Examples of Minimum Collection Service Standards and Environmentally-Sound Management

Compliance	Reporting	Operations
• Proof of proper licensing for drivers • Business registration and licensing as required by local and state government • Proof of compliance with minimum driver and worker safety standards and programs • Compliance with all applicable environmental laws • Record keeping	• Ability to track and report materials and services data (tons, households, non-residential entities) and disposition of covered materials collected from covered entities • Ability to meet financial reporting standards for reimbursement claims process (i.e. recycling costs per household)	• Proof of insurance, including environmental liability coverage • Proof of compliance with minimum customer service standards • Ability to collect MRL materials with available infrastructure by the program implementation date • Hours of operation and minimum material handling for drop-offs • Others as required to meet program goals

The MSA will establish the basic terms and conditions of the reimbursement agreement. MSAs will include standard conditions common to the industry and may include additional terms and conditions required for the Program such as: insurance, permitting, licensing, compliance, and other standards; worker health and safety standards; environmentally sound management practices; financial assurances; invoicing and payment terms; claims verification requirements; financial reviews and audits; participation in material characterization audits; dispute resolution, and confidentiality. CAA Colorado anticipates that service agreements will include confidentiality provisions that will, in part, protect the commercially sensitive information of Colorado service providers.

In addition to the MSA provisions focused on protecting the commercially sensitive information of Colorado service providers, data submissions from Colorado service providers to CAA Colorado will be limited to the data necessary to accurately verify claims and meet program requirements. CAA Colorado must comply with the Colorado EPR Law, the Colorado Regulations, and the Colorado Program Plan approved by CDPHE. As such, it is anticipated that some of the information provided by Colorado service providers may need to be provided to CDPHE, and may be subject to the Colorado Open Records Act, C.R.S. 24-72-201 to -206. To facilitate the confidentiality protections afforded by the Colorado Open Records Act, information that is provided to CDPHE by CAA Colorado will incorporate any confidentiality designations included by Colorado service providers when providing information to CAA Colorado.

Service agreements will also include SOWs that will cover specific services, service expansion, reimbursement rates and units, data collection and reporting, and other details. SOWs may include requirements such as: collection standards; cart and container standards, maximum allowable levels of contamination, material destination standards (collection, post-collection); reimbursement rates by service type, unit, and zone, escalation (i.e. Consumer Price Index (CPI)); performance incentives; data tracking and reporting (i.e. households serviced, tons collected, material destinations); participation in material composition studies; customer engagement standards; duration; and other terms as needed.

Participating collectors must meet and maintain compliance with the minimum service standards. CAA will consider the impact of the minimum service standards to best enable eligible service providers interested in participating in the program having an opportunity to do so. Service agreements will include a process for monitoring ongoing compliance with required service standards and conditions under which a collector may be deemed to be no longer in compliance with the required service standards of the program. This process would include the ability for CAA Colorado or a third-party to audit service providers to ensure participants are in compliance with CAA Colorado's requirements, such as environmental or health and safety. Agreements may include financial penalties for non-compliant collectors as well as conditions under which a service agreement may be suspended or revoked.

Delivery to Participating Post-Collection Locations

Excerpt from the Act
25-17-705 (4)(g) Establish recycling practices that: (III) Ensure that any covered materials collected for recycling will be transferred to a responsible end market.

Collectors must report the tons of MRL and AML materials from covered entities that are delivered to participating post-collection locations (transfer facilities, MRFs) for claims verification. To meet the required data tracking and REM requirements, CAA Colorado will only reimburse collectors for MRL and AML materials from covered entities that are delivered to locations participating in the Program. Notwithstanding any existing contracts that are in place prior to Program implementation, collectors will not be charged processing fees[16] delivered to participating processors for covered residential loads.[17]

CAA Colorado will reimburse the collector's costs of transportation to the nearest participating post-collection location or participating post-collection locations within a specified geographic boundary, that have capacity and capability to process covered MRL materials. If a collector

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[16] A processing fee is the charge levied upon a given quantity of material received at a processing facility such as a transfer or material recovery facility

[17] Mixed commercial/residential loads will still be charged a processing fee. CAA Colorado will reimburse collectors for these processing fees based on an allocation of the number of cubic yards of service. Refer to the *Multifamily Service Operations Plan* Section of this chapter for additional information.

chooses to deliver materials to a different post-collection processor, CAA Colorado will not cover the additional transportation costs, unless mutually agreed to. If a collector must deliver materials to a post-collection location outside of their zone due to forces outside its control, these costs may be covered in the reimbursement payment. Service agreements will outline the conditions that may require materials to be delivered to locations in other collection zones.

Collection Data and Verification

CAA Colorado will require collectors to report data such as the quantity of materials collected, number of entities serviced, collection service costs, and other data required to:

- Verify reimbursement claims.

- Calculate program performance.

- Identify opportunities for continuous improvement to increase the material recovery rate, reduce Program costs, and promote best practices.

- Identify eligible costs.

- Calculate payments to service providers.

- Calculate potential deductions to Reimbursement claim should service levels fall below minimum requirements and/or requirement for corrective actions.

CAA Colorado will verify service provider data, which may include an audit of the tonnage data submitted, covered entities serviced, and submitted costs. All cost data must be for recycling services to covered entities for covered materials. When actual cost data is used for reimbursement, a third-party auditor must certify the data to ensure that recycling costs are isolated from other solid waste services.

6.3 Multifamily Service Operations Plan

Covered entities include all single family or MFUs, therefore CAA Colorado must cover the net service costs for recycling collection for MFUs. There are 2.2 million housing units in Colorado, 26 percent of which are MFUs. Tables 11 and 12 below present the Needs Assessment summaries of Colorado's housing stock by region.

Table 14: Number of Housing Units by Type and Region

Region	Total Households	Single Family	2–9 Units	10+ Units	Mobile Homes
Front Range	1,790,240	1,235,266	161,122	340,146	35,805
Eastern Plains	153,588	119,799	10,751	7,679	13,823
Western Slope	183,677	130,411	18,368	12,857	20,204
Mountain	100,427	67,286	10,043	17,073	6,026
TOTAL	2,227,932	1,552,761	200,283	377,755	75,858

Table 15: Percentage of Housing Units by Type and Region

Region	Single Family	2–9 Units	10+ Units	Mobile Homes
Front Range	69%	9%	19%	2%
Eastern Plains	78%	7%	5%	9%
Western Slope	71%	10%	7%	11%
Mountain	67%	10%	17%	6%
TOTAL	70%	9%	17%	3%

Existing Service Structures: Municipalities with contracted or local government collection often include recycling collection services for MFUs of up to and including seven units. However, because of CRS 30-15-401[18], all MFUs with eight or more units are provided services through an open market subscription. The billing depends on the municipality, the MFU ownership, and the existing agreements. In some cases, residents will be billed directly for services, or the costs of the services are included as part of the HOA fees or rent.

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[18] CRS § 30-15-401. General Statute describes the powers of counties and local governments to regulate solid waste services.

Reimbursement Approach

Local Government Collection: Collection services for MFUs (up to and including seven units) on residential routes (i.e. cart-based collection) will be included in local government service agreements and reimbursement formulas. Additionally, if local governments provide MFU collection in shared containers (i.e. dumpsters or compactors) routes, these service costs will be included in the service agreements and reimbursements as well.

Local governments will report the actual costs of isolated recycling services, plus administration, for reimbursements. For local governments that are unable to isolate their recycling service costs, CAA Colorado will calculate a per household reimbursement rate based on the local government's best available data and an estimated cost, like single family services. If needed, CAA Colorado will use other data sources, (e.g., the average split between disposal and recycling costs when co-collected) to estimate a MFU costs for reimbursement. Service agreements with local governments will include language to move toward an actual cost reimbursement methodology as additional data is obtained.

Depending on existing agreements between local governments and MRFs, the reimbursement formula may include processing fees. As CAA Colorado expands service agreements with post-collections service providers, including transfer facilities, and the pre-existing agreements expire, local government collection reimbursements will no longer include processing fees.

Contracted Collection: Like local government collection reimbursement, contracted collection services for MFUs on residential routes will be included in local government reimbursement formulas. The local government is required to obtain isolated recycling services costs from their contracted service provider for the reimbursement submission, and reimbursement for these services must be based on actual costs. When actual costs for recycling cannot be isolated by the service provider, CAA Colorado will work with the local government to estimate a reasonable cost for reimbursement (e.g., based on comparable municipal servicing). The local government will also be reimbursed for its administrative costs based on the allowable administrative expense in the reimbursement cost formula.

Depending on the existing contract, the reimbursement rates may include processing fees. In future years, processing fees will not be part of the collector reimbursements as CAA Colorado will be directly reimbursing MRFs.

Open Market Collection: CAA Colorado proposes differentiating the MFU reimbursement rate by collection type, rather than number of units or size of structure, for the following reasons:

- Collection costs vary significantly between shared container (i.e. dumpsters or compactors) and cart collections.
- Cart based collections are typically residential routes only.

- Materials from MFUs in shared containers are frequently collected on mixed commercial and residential routes, creating issues with data and cost isolation.

- Materials from mixed routes are delivered to MRFs on a single load, creating challenges in data and costing for processing fees and processing reimbursements.

- Collections from covered non-residential entities are not eligible for reimbursements until 2028 or later, depending on entity type.

Multifamily Approach

Step 1 – Open Market Request for Reimbursement: Like the process for other collection reimbursements, all service providers interested in participating in the Program will first need to be qualified. During the RFR process, service providers will be asked if they currently service MFUs, or plan to do so in the future.

Step 2 – Qualification: There is one minimum service standard qualification process for the entire state, regardless of the market zone. Qualified service providers are eligible to participate in any zone, provided they meet the service standards, and those interested in participating in reimbursements for MFU collection are invited to move to step three.

Step 3 – Service Agreements: Qualified collectors are invited to participate in as many zones as they choose. It is expected that a MSA will be established with qualified vendors, which will include individual statements of work for different service types and zones where pricing may vary. Service agreements for MFU collection will be based on one of the following options:

- *Cart Collection on Residential Route – Zone Price*: The same process used to establish service agreements for collectors servicing single family households in open subscription zones will be apply to MFUs that are collected with carts or bins on residential routes. The published zone pricing will be on a per household basis, with service providers invited to accept the respective zone price. In instances or areas where the zone price does not fully cover the costs of service, CAA Colorado will consider a reimbursement rate for qualified vendors based on cost data submitted. Like single family residential reimbursements, MFU collection reimbursements that are on fully residential routes will not include processing fees. CAA Colorado expects to enter into service agreements with qualified post-collection service providers that will cover the net service costs. CAA Colorado will thus cover the costs of processing through post collection reimbursements, and collectors will not be charged processing fees for processing residential routes at participating MRFs.

- *Shared Container Collection – Dedicated Multifamily Routes:* Qualified vendors who wish to provide shared container collection services (i.e. dumpsters or compactors) for MFUs will be asked to provide CAA Colorado with a per cubic yard rate for collection in each zone in which they wish to participate. There is no requirement to provide different rates for each

zone, and vendors are encouraged to offer the same rate for multiple zones. Service providers will be reimbursed on a per cubic yard basis for services to residential entities only. For example, an MFU with an eight-cubic yard container serviced twice weekly would be reimbursed for 16 cubic yards of service. CAA Colorado may also consider alternative unit rates for reimbursement such as per pull or per address in areas where it is required. CAA Colorado will consider paying a premium rate for dedicated MFU residential routes, or for collectors that choose to transition from mixed commercial/residential routes to residential-only. When possible, CAA Colorado will work with collectors to transition mixed MFU/commercial routes to dedicated residential routes for ease of data tracking and isolating costs like single family residential reimbursements, MFU collection reimbursements on fully residential routes will not include processing fees. Post-collection service agreements will cover the net service costs of processing through the MRF, or transfer facility, and there will be no processing fees for these routes.

- *Shared Container Collection – Mixed Commercial and Multifamily Routes:* Service providers will be reimbursed on a per cubic yard basis for services to residential entities only. Additional collections provided to non-residential entities on the same route are not covered in the reimbursement.

- *Processing Fees:* Reimbursements for mixed routes collected in shared containers will include the cost of processing fees for the multifamily portion of the route. MRFs will not be reimbursed for the processing costs of materials from MFUs delivered in mixed commercial/residential loads. Instead, MRFs will charge a processing fee to cover the costs of service, and the reimbursement for the processing costs will be between CAA Colorado and the service collector[19].

Under any scenario, the service provider will no longer include a fee for recycling services to MFUs, with CAA Colorado paying these costs. Regular financial reviews with the service agreements will be used to ensure that service providers are not charging its customers for reimbursed recycling services.

6.4 Single Family Homeowner Associations Operations Plan

The approach to reimbursement for single family HOAs is described below. Multifamily HOA services will be considered multifamily service and are described in the *Multifamily Service Operations Plan* Section.

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[19] This will eliminate the need for participating MRFs or collectors to estimate which portion of each mixed load delivered to a processor are from covered residential entities versus non-covered entities, which would result in a partial but unknown reduction in processing fees.

Reimbursement Approach

Local Government Collection: HOAs that are collected by the local government will be included in local government service agreement and reimbursement formulas. Service agreements with local governments that are unable to report isolated recycling costs will include language to move toward an actual cost reimbursement methodology in future years.

Contracted Collection: Like local government collection reimbursement, HOAs collected through a contracted collector included in the local government contract are included in local government reimbursement formulas.

Open Market Collection: The approach for HOAs that contract directly with service providers for recycling services is like that of open market subscriptions. Once qualified, service providers with existing contracts for HOA recycling services may be eligible for reimbursement. CAA may conduct cost reviews to ensure that recycling service costs for HOAs are based on fair market values for the region or zone. HOA reimbursement to service providers may require the following information:

- Name of HOA
- Copy of contract
- Isolated recycling costs on a per residential unit basis
- Covered entities with recycling service
- Material destinations (materials must be delivered to a participating post–collection service provider)
- Additional information as required by final service agreement

Under any collection scenario, the service provider must no longer include a fee for recycling services to covered entities, as CAA Colorado is responsible for paying this cost.

6.5 Calculation of Net Recycling Cost Reimbursements: Collection

Excerpt from the Act

25-17-705 (4)(j) Include reimbursement rates for one hundred percent of the net recycling services costs of the recycling services provided by service providers under the program consistent with the requirements of section 25-17-706. The reimbursement rates must: (I) Be calculated using an objective cost formula or formulas; (II) Incorporate the relevant cost information identified by the needs assessment pursuant to subsection (3)(a)(III) of this section; (III) Be calculated on a per unit basis such as per ton, per household, or other unit of measurement; and (IV) Take into account: (A) Regional recycling services costs; (B) Population density; (C) The number and types of households served; (D) The collection method used; (E) The revenue generated from covered materials; (F) The amount of inbound contamination and other factors affecting the quality of covered materials; and (G) Other demographic factors identified in the needs assessment pursuant to subsection (3)(a)(III) of this section.

Eligible Costs

The collection cost formulas vary by service type and the service provider being reimbursed. A general description of the types of costs included in the various reimbursement cost formulas is provided below.

Operating Expenses: Include both the variable expenditures for the collection of materials from covered entities and the fixed costs of the service provision. Operating costs include items such as payroll costs of truck drivers, collectors, drop-off staff; customer service, supervisor, and management costs directly related to the provision of recycling services to covered entities; services such as utilities, insurance, and cart delivery, repair and maintenance; supplies such as fuel or transportation costs, rent or lease costs for buildings, equipment, or vehicles, and other variable costs. Operating costs also include the administrative cost[20] incurred by service providers in direct support of collection operations such as financial, human resources, including health and safety, labor and employee relations, training, and development, information technology, data collection and reporting, and others.

Capital Expenses: Capital costs include the recycling service to covered entities portion of the amortized capital cost of collection equipment, truck, signage, facilities, fixed and mobile equipment, and collection containers. Any grants (e.g. CDPHE provided grants for carts or trucks) for capital improvements will be subtracted from the amortized capital costs determined for the service provider.

Education and Outreach Expenses: Includes the costs to promote the Program and educate covered entities on local recycling practices per the minimum service agreement standards. Costs

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[20] Administrative costs are the indirect, day to day expenses incurred to manage and run recycling services.

may include elements such as printing and mailing, website, widgets, or phone apps, stickers, or other materials.

Debt Service: Includes payment for interest and principal on debt obligations used for recycling services.

Other Income: Includes income from the sale of covered materials as well as income from grants, cart sales, or other funding sources that offset the delivery of recycling services. It does not include payment for services, either through direct billing, property taxes, or general fund.

Tip Fees: Tip fees for materials delivered to post collection facilities are not included in reimbursement cost formulas. These fees, or revenues, are historically paid or received by collectors who deliver recyclable materials to a post-collection site. However, under the Program post-collection service agreements, CAA Colorado will cover the net processing costs for approved post-collection sites. Thus, tip fees will not be levied to collectors at these sites and are not included in the cost formula. Exceptions will be considered in cases where collectors have existing contracts with post-collection service providers, and the collector's existing contracts with local governments or other entities include processing fees in the collection costs.

Service agreements will reimburse service providers for the net service costs. Profit margin is included in the net costs of recycling services for non-local government service providers. For open market collections, the profit margin is included in the negotiated unit cost (per household, per cubic yard). For local government contracted collection, the profit margin is included in the contract between the collector and the local government, which will be reimbursed by CAA Colorado. CAA Colorado will monitor profit margin with the expectation that they are within industry norms.

If a participating collector levies a financial penalty directly to their customer, this penalty will not be reimbursed by CAA. This cost is between the collector and their customer.

Participating post-collection processors will be required to accept loads of covered MRL materials from covered entities from participating collectors that meet agreed upon service standards. Post-collection service agreements will include conditions under which a processor may reject loads from participating collectors. If a participating post-collection service provider rejects a load due to unacceptable contamination levels, the collector's costs of managing the rejected load will not be reimbursed.

Collection service agreements will outline the activities, including base level education and outreach, that service providers must maintain to limit contamination. CAA Colorado does not expect service providers to collect containers that exceed allowable contamination thresholds established in service agreements. The activities CAA will undertake to reduce contamination are described in Chapters 8 and 10. CAA Colorado expects the service provider's reasonable costs to

manage contamination, including base levels of education and outreach, to be included in service reimbursement.

Incentives for Exceeding Convenience Standards and Recycling Rates

Scopes of work for service agreements may include collector reimbursement incentives to encourage exceeding convenience standards, increasing recycling over the target rates, and other programmatic aims. Examples of incentives may include exceeding contamination levels, expanding services to underserved areas, expanded worker health and safety measures, or others. Incentives would be clearly identified in service agreements and reimbursed to qualified collectors on a per household or percentage basis.

Local Government Collection Cost Formula

Eligible net collection costs for local government provided services and open market services are calculated as the sum of eligible operating costs, administrative costs, required education and outreach costs, capital costs, and debt service, less other income – as shown below.

> **(Operating Costs + Capital Costs + Education and Outreach Costs + Debt Service) – Other Income**
>
> **=**
>
> **Cost Reimbursement**

Modeled Cost for Local Government Reimbursement Cost Formula

Some local governments may not have isolated recycling costs for services to covered entities as they are unable to segregate these costs from other solid waste costs at program onset. For local governments that cannot report their isolated actual recycling costs, CAA Colorado will use calculated costs in the initial service agreement. CAA Colorado will coordinate with the local government to estimate costs to provide recycling services based on their actual activities. The reimbursement cost formula is presented below. The service agreement will include a pathway toward the provision of third-party verified actual costs via standardized data call in future service years.

> **(Calculated Operating Costs + Calculated Capital Costs + Calculated Education and Outreach Costs + Calculated Debt Service) – Calculated Other Income**
>
> **=**
>
> **Cost Reimbursement**

Contracted Collection Cost Formula – Local Government Billing

The cost formula for contracted collection is based on actual costs of recycling collection incurred by the contracted collector and billed to the local government. Local governments with contracted collectors will be required to obtain isolated recycling costs from their contracted service provider and submit the costs for reimbursement. The collector's profit margin is included as part of the contract between the collector and the local government, which will be reimbursed. The reimbursement formula also includes an EPR administration expense, which includes the costs incurred by local governments to participate in the EPR program but are not directly tied to collection operations. The allowable administration expense will be based on a specified fixed percentage of total contracted service cost. Base level education and outreach costs may also be included in the costs formula and will depend on the service agreement and who provides education and outreach. Like local government collection, if the contract includes any commodity revenue share for the materials collected, the other income is subtracted from the costs prior to the determination of reimbursement.

(Contracted Costs + EPR Administration Expense (%) + Education and Outreach Costs) – (Other Income)

=

Cost Reimbursement

Contracted Collection Cost Formula – Contracted Collector Billing

In collection systems where the contracted collector is responsible for billing covered entities and collecting payments, the service agreement and reimbursement will be between CAA Colorado and the contracted collector, not the local government (pending an agreement between the local government, the contracted collector, and CAA Colorado to assign it the authority to pay the service provider). The cost formula for contracted collection is based on actual costs of collection incurred by the contracted collector. The contracted collector will be required to submit a copy of the local government contracts and third-party verified actual costs. The reimbursement cost formula is presented below.

Unit Price ($ / HH) from local government contract x Number of HH serviced

=

Cost Reimbursement

Open Market Cost Formula

Private collectors in open markets will be encouraged to seek reimbursement of eligible net collection costs through zone pricing. This zone price reimbursement rate will be calculated on a per household basis. Zone pricing will be established by CAA Colorado and will vary by service zone. Service providers that accept the zone price under the service agreement are reimbursed based on the zone pricing rate and are not required to submit cost data to CAA Colorado.

Zone pricing will be published on a cost per household basis which will include the eligible costs of providing recycling collection services. The service provider's profit margin is included in the unit cost established between CAA Colorado and the collector. A service provider may operate in multiple zones. The reimbursement cost formula is based on the number of covered entities serviced per zone and the unit price for the serviced zone. The reimbursement cost formula for zone pricing is presented below.

$$(\text{zone price}^{\text{ zone a}} \times \text{covered entities serviced}^{\text{ zone a}}) + (\text{zone price}^{\text{ zone b}} \times \text{covered entities serviced}^{\text{ zone b}}) + (\text{zone price}^{\text{ zone z}} \times \text{covered entities serviced}^{\text{ zone z}})[21]$$

$$=$$

$$\text{Cost Reimbursement}$$

If the published price does not cover the service provider's cost of service in a particular zone, or portion of a zone, qualified service providers are invited to submit a request for an actual cost reimbursement. CAA Colorado will require that cost data submitted for actual cost reimbursement is verified through a third party. CAA Colorado reserves the right to negotiate actual cost reimbursements.

Similar to zone pricing, the service agreement for actual cost reimbursement in open markets will include an established unit cost for services which may vary by zone. A collector may agree to a zone price in one zone and require an actual cost in a second zone. The basic formula is below.

$$(\text{Actual unit price}^{\text{ zone a}} \times \text{Units serviced}^{\text{ zone a}}) + (\text{Actual unit price}^{\text{ zone b}} \times \text{Units serviced}^{\text{ zone b}}) + (\text{Actual unit price}^{\text{ zone z}} \times \text{Units serviced}^{\text{ zone z}})[22]$$

$$=$$

$$\text{Cost Reimbursement}$$

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[21] There is no limitation to the number of zones a single collector may choose to service.
[22] There is no limitation to the number of zones a single collector may choose to service.

Zone Pricing Reimbursement Rates

Colorado has diverse operating conditions that will dictate the need for many service zones and zone prices. The zone prices will incorporate the cost information identified in the Needs Assessment and will account for the regional service costs, demographics, geography, available infrastructure, and other factors. Zone sizes will vary based on the factors in each region. Initial market research and service costs modeling indicates that majority of zones will have zone prices that may fall between a range of $7.00 to $19.00 per household per month, depending on the zone, market conditions, and other factors. However, in the challenging service areas of the state, the regions with less dense routes, or areas with greater distances to consolidation points, the open market service are often significantly more expensive per household per month. CAA Colorado anticipates that in these challenging service areas, the net recycling service costs will fall outside of the published zone pricing. Thus, these areas will likely require actual cost reimbursement agreements between CAA Colorado and service providers. Zones and zone prices will be further refined in 2025 and released after approval of the Program by CDPHE, and at the start of Program implementation. Following the initial publication, zone pricing will be evaluated by CAA Colorado on at least every two years to ensure that they are reflective of the net regional service costs.

Table 16 presents the findings of CAA Colorado's initial analysis of open market zone price reimbursement rates. The zone price will vary, and the published rates may fall outside the initial ranges presented in the table. Service costs that exceed the zone pricing will be reimbursed through actual cost agreements.

Table 16: Potential Open Market Zone Pricing Ranges

Potential Open Market Zone Pricing Ranges	Low	High
Front Range[23] ($ / HH / month)	$6	$18
Greater Colorado[24] ($ / HH / month)	$7	$21

6.6 Process for Evaluation and Revision of Objective Cost Formulas: Collection

Excerpt from the Act
25-17-705 (4)(k) Describe the process to evaluate and revise the objective cost formulas as necessary and using documented costs. If the plan proposal includes more than one objective cost formula for recycling services, the plan proposal must describe the conditions under which each formula will be applied.

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[23] The Front Range includes the counties of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, El Paso, Jefferson, Larimer, Pueblo, and Weld.
[24] CDPHE defines 'greater Colorado' as including the 53 counties outside of the Front Range.

CAA Colorado will undertake collection cost studies and analysis to assess service agreement costs and incentives, and to compare and evaluate collection reimbursement rates within zones or regions. Collection cost studies will be completed at least once per five-year program period and may be conducted more frequently, if needed.

CAA Colorado will use these studies to evaluate the effectiveness of contracted actual costs, modelled costs, and zone pricing reimbursements. This information will also be used to inform reimbursement when establishing new service agreements and evaluating the objective cost formulas for collection. The conditions under which the objective cost formulas may be revised include, but are not limited to:

- Market related issues that jeopardize the outcomes sought in the program plan
- Legislative policy or rulemaking changes
- Recommendations provided by CDPHE

At Program launch, and as services are phased in, CAA Colorado will encounter contracts that have different expiration dates. The information from these cost studies may be used to update service agreement provisions.

CAA Colorado reimbursement service agreements will be multi-year contracts intended to provide service providers with price stability and reliability. Over the term of the contract, CAA Colorado and service providers will collaborate to add infrastructure and drive efficiencies that can influence costs. Service agreements will be structured to be forward-looking over the term of the agreement to accommodate for service and infrastructure expansion and will also include conditions for when cost evaluation or adjustments are needed.

6.7 Reimbursement Rate Schedule – Collection

Excerpt from the Act
25-17-705 (4)(I) Include a schedule of reimbursement rates for service providers that elect to participate in the program and be reimbursed by the organization for providing recycling services for the program and describe a process for updating the schedule periodically and as necessary

Reimbursement agreements will depend on the collection model and the service provider's ability to isolate recycling costs from other solid waste costs. Due to the variety of collection models in Colorado, multiple reimbursement structures will be established.

Local governments will be reimbursed for the net service costs of their recycling services, including collection and drop-off. For local governments that cannot isolate these costs, modeled costs based on available data may serve as a basis for reimbursement, negotiated per municipality. As local governments improve their data collection and accounting practices, they will transition from modeled to actual cost submission and reimbursement.

Private service providers operating in the open market will have the opportunity to enter into service agreements based on zone pricing or actual cost reimbursements.

Contracted services will be reimbursed based on the actual service costs, and reimbursements will either go to the municipality or the contracted collector, depending on who bills for the services.

These approaches are summarized in the Reimbursement Rate Schedule in the table below.

Table 17: Collection Reimbursement Rate Schedule

Collection Model	Type of Service Provider	Who CAA Colorado will Reimburse	Basis for Reimbursement	Reimbursement Unit
Local Government Drop-off	Local Government	Local Government or Private Service Provider	Actual cost provided by local government	Submitted costs of service
Private Service Provider Drop-off / Depot	Private Service Provider	Private Service Provider (including Non-profit)	Actual cost provided by service provider	$ / Ton
Local Government Collection	Local Government	Local Government	Actual Cost provided by local government *or* Modeled Cost negotiation	Submitted annual costs of service
Local Government Contract	Private Service Provider	Local Government	Actual Cost provided by local government via contracted collector	Cost per covered entity from local government / collector contract
Local Government Contract	Private Service Provider	Private Service Provider	Actual Cost provided by contracted collector	$ per Covered entity serviced per month from local government / collector contract
Open Market	Private Service Provider	Private Service Provider	Zone price (see zone price section) or Actual Cost provided by contracted collector	$ / Household serviced / month

Open Market – non-residential	Private Service Provider	Property Manager, Private Service Provider	Negotiated price provided by collector	$ / Cubic yard

For all service types, collectors must submit reimbursement claims through CAA Colorado's service provider portal. Claims can be submitted monthly, quarterly, or annually and CAA Colorado will verify claims and issue reimbursements. The portal will allow users to easily track the status of their submissions. Additional information on required data for claims verification and payment terms will be included in service agreements terms and conditions.

Service Expansion and Continuous Improvement: Collection

Collection services agreements are intended to provide predictability and stability over time to accommodate service expansion and addition of MRL materials. Services agreements will include language for expansion of service and contain statements of work structured for both existing and expanded service. CAA Colorado recognizes that it may need to wait until existing local government service agreements expire before expanding services.

To ensure appropriate reimbursements, agreement terms with service providers may include the following:

- Advance notification of proposed changes to recycling services, program design, and delivery that impact service costs.
- Changes to MRL or AML, and post-collection locations.
- Education and outreach activities when new services are established, and materials added to MRL.
- Support for contracted collection agreements, such as assistance with contract language for expiring contracts where the local government is preparing to procure collection services.
- Adjustments to rates based on annual reviews and studies of collection reimbursement costs across Colorado.
- Data handling and confidentiality.

Where needed CAA Colorado will work with local governments to identify opportunities to update existing contracts to reflect equivalent standards and minimum service level requirements (e.g. collection frequency, minimum recyclable materials, facility destinations). CAA Colorado will collaborate with local governments on collection reimbursement elements that cannot be met due to existing contracts. CAA Colorado will develop preferred public RFP and contract language for local governments to consider for future service provider procurement done in a fair, open, and competitive manner, meets minimum service standards, and ensures claims verification data can

be easily collected and reported. Decisions to move to contracted collection and contracted collection procurement will be made by local governments.

6.8 Approach to Post-Collection Reimbursement

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Excerpt from the Act

25-17-705 (4)(g) Establish recycling practices that: (II) Use open, competitive, and fair procurement practices when entering contracts with service providers, and, when entering into contracts with private service providers, adopt a preference for service providers with strong labor standards and worker safety practices

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Service providers wishing to participate in CAA Colorado's transfer or processing reimbursement program must enter into service agreements. Post-collection services include receiving covered materials from collection, consolidation and transport of materials from transfer facilities, and receiving, sorting, and preparing materials for market.

CAA Colorado will use open and fair procurement processes with transparent service requirements to establish agreements with service providers for the reimbursement of post-collection services, and for the expansion of services.

CAA Colorado will contract directly for post-collection services. Post-collection service providers will be responsible for marketing processed materials to REM. Post-collection service providers may engage subcontractors to provide services. Once completed, service agreements will detail service standards, reimbursement rates, duration, and claim verification requirements.

Contracted payments will be based on the performance defined in the statements of work. Stability will be provided through service agreements in multi-year contracts with service providers. Agreements will leverage per ton reimbursements for the expansion of the quantity of MRL material and the addition of new materials from the AML list that is needed to reach the Program's collection and recycling rate targets.

Transfer Facilities: Transfer facilities will receive, handle, consolidate, and transport covered materials from specific collection points to MRFs or REM. They may also do limited sorting of material prior to consolidation and transportation (push and bale). CAA Colorado aims to have transfer facility service agreements stop charging processing fees to participating collectors for AML and MRL materials. CAA Colorado will directly reimburse transfer facilities for net processing costs including transportation to participating MRFs.

Material Recovery Facilities: MRFs participating in the Program will receive materials from collectors and sort, prepare, and market materials to REM. CAA Colorado aims to have MRF service agreements stop charging processing fees to participating collectors or transfer loads for AML and MRL materials from covered entities. CAA Colorado will directly reimburse MRFs for net processing

costs. Under the reimbursement model, participating MRFs can realize the following Program benefits:

- **Additional Feedstock:** The Program will increase access to recycling services across Colorado, reimbursing collectors for tons delivered to participating processors, thus increasing their feedstocks.

- **Reduced Risk:** Processors' reimbursements mitigate the risks of commodity markets downturns through the negotiated agreements and processing reimbursement cost formulas.

- **Steady Income Stream:** Processors can rely on reimbursements for the duration of their contract, providing stability for long-term planning.

- **Investment and Growth:** Long-term agreements reduce the risks associated with capital investments and provide additional funding pathways for increasing efficiency, sorting capabilities, bale quality, or adding new materials.

- **Innovation:** CAA Colorado is dedicated to continuous improvement and identifying innovations to improve the recycling system. CAA Colorado plans to work alongside collectors and processors to continually improve the recycling system and the Program.

Establishing Post–Collection Service Agreements

The process for entering into service agreements will be conducted via the three–step request for reimbursement:

1. Post-Collection Request for Reimbursement: Including publication of minimum service standards and agreement terms.

2. Qualification: Ability to meet performance requirements by the start of the program and to maintain standards for duration of service agreement.

3. Service agreement: Pricing and negotiations.

CAA Colorado will leverage the state's existing public and private infrastructure in meeting the program objectives and create opportunities for new investments.

Request for Reimbursement: Upon release of the Post Collection RFR, CAA Colorado will conduct meetings with interested post–collection service providers to introduce the goals and objectives for the service and/or region under consideration. CAA Colorado will provide clear specifications for processing service agreements, including labor standards, worker safety expectations, sound environmental management practices, MRL and ARL materials, and reimbursement requirements. The RFR will also outline the anticipated service agreement terms and conditions. Any additional addenda or response to questions required will be made public.

Qualification: Interested service providers will be requested to provide a response to the RFR that details their background, experience, and offerings for the region, and the types of services requested. CAA Colorado expects service providers to provide an estimate of the anticipated reimbursement costs and timing. This qualification step will also allow CAA Colorado to determine if a service provider can raise capital for recycling services and future expansion, if a roadmap for the acceptance of certain MRL and AML materials is needed, and what pricing incentives may be needed to encourage the facility to operate more efficiently. Service providers that meet the minimum service criteria are qualified and are invited to enter service negotiations. For service providers that failed to qualify, CAA Colorado will collaborate with them to improve qualifications, such as submitting a plan to improve the deficiency before attempting to re-qualify.

It is not necessary to currently provide services in the state to qualify. For example, if an organization is building a new MRF in Colorado, but the MRF is not yet operational, it could still respond to the RFR and become qualified.

Service Agreement: Qualified service providers will be invited to negotiate service agreements. Service providers will be asked to supply an offer for pricing for processing, with CAA Colorado retaining the right to negotiate competitive pricing. CAA Colorado will then award service agreements for selected vendors. Service providers that either miss or choose not to participate in the initial period will be able to submit an RFR in a future round after the initial service agreements have been established.

Post-Collection Service Agreement Standards

The services agreement will set out the minimum requirements that a provider must continuously meet to be eligible to receive Program payments. The requirements are intended to support the continued delivery of post-collection recycling services to covered entities for covered materials in Colorado.

Transfer and MRF processing qualification standards will include basic qualifications historically common to the industry, with additional requirements that enable data reporting, material class and quality standards, and material tracking unique to the Program. Local governments, tribal nations, private companies and not-for-profit organizations that meet qualification standards are eligible to enter into reimbursement agreements as transfer facilities or MRFs. Service provider participation in the Program is voluntary.

Listed in Table 18 below are the types of minimum qualification standards that CAA Colorado will require, while reserving the right to update and change as needed.

Table 18: Examples of Minimum Post-Collection Service Standards and Environmentally-Sound Management

Compliance	Reporting	Operations
• Proof of proper permitting • Business registration and licensing as required by local communities and state • Proof of compliance with minimum worker safety standards and programs, and ability to provide data on these programs • Compliance with all applicable environmental laws • Record keeping	• Ability to track and report materials and services data for covered MRL and AML materials from covered entities (tons in, tons outs) and disposition of covered materials collected from covered entities • Ability to meet financial reporting standards for reimbursement claims process (i.e. recycling costs per household)	• Proof of insurance, including environmental liability coverage • Proof of compliance with minimum customer service standards, performance data and/or ability to provide this data • Ability to accept and process MRL materials • Hours of operation and minimum material handling for drop-offs • Others as required to meet program goals

Like the collection agreements, post-collection service agreements will include an MSA which establishes the standard terms and conditions of the reimbursement agreement. When facilities are owned by one entity but operated by another party, MSAs are expected to be between the facility owner and CAA Colorado. In some cases, there may be a three-way agreement.

Service agreements will include SOWs specific to each post collection service facility, covering certain services, service expansion, reimbursement rates and units, data collection and reporting, and other details.

SOWs for transfer facilities may include requirements such as receipt of MRL materials from service providers; storage and consolidation of material; transport of materials to a MRF or other receiving facilities, and participation in contamination and material characterization audits. They will also detail the allowable reimbursement costs, reimbursement rates by per ton processing fees with escalation (i.e. CPI), and transportation cost reimbursement rates.

SOWs for MRF processing may include requirements such as acceptance and processing of MRL[25] materials; material processing standards and specifications; REM material destination standards,

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[25] The service agreement will include a defined pathway to acceptance of MRL materials for MRFs that currently do not process all MRL materials. They will also include considerations for adding AML materials through CAA Colorado post-collection continuous improvement investments.

allowable reimbursement costs; reimbursement rates[26]; participation in material composition studies; customer service standards; and duration.

SOWs will also include terms to account for capital expenditures and variable cost reductions as new materials are added and systems are improved. Contracts will include opportunities for per-ton processing fee adjustments to reflect the impact of capital investments or new materials on processing costs and encourage post-collection service providers to invest in technology to improve efficiency.

Participating post-collection processors will be required to accept loads of covered MRL materials from covered entities delivered by participating collectors that meet agreed upon collection service standards. Post-collection service agreements will also include the specific conditions under which a processor may reject loads from participating collectors.

Participating post-collection service providers must meet and maintain compliance with the minimum service standards. Service agreements will include a process for monitoring on-going compliance with required service standards and conditions under which a processor may be deemed to be no longer in compliance with the required service standards of the program. Agreements may include financial penalties for non-compliant collectors as well as conditions under which a service agreement may be suspended or revoked.

As part of the service agreements with processors, CAA Colorado will consider including an optional mechanism that would provide producers with an ability to purchase material bales (initially PET bales). The mechanism would provide an option for producers to make individual requests to purchase PET bales at market rates. Market rates will be based on a price index recognized by the industry. CAA Colorado would not seek to disrupt processor's long-term agreements and would not directly purchase bales. Instead, the individual producer would become the buyer of the PET bales. CAA will also collaborate with MRFs to consider other options to increase the amount of PCR materials that are available to producers.

Processing Fees: CAA Colorado aims to transition to a system in which processing fees are no longer charged for MRL and AML materials from covered entities and delivered by participating collectors. Service providers will be reimbursed by CAA Colorado for eligible net service costs, resulting in service providers no longer requiring processing fees to cover the costs of processing. However, under certain pre-existing collection and processing arrangements, processing fees may still be charged. In these cases, CAA Colorado will reimburse processing costs via collection service agreements to avoid double payments. Examples of these conditions are summarized below:

- **Local Government Collection, Existing Contract:** Where local government collected material is delivered to a participating processor, and there is a pre-existing contract

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[26] Facilities may request confidential business information protection on the amount and destination of materials recovered for recycling data submitted to the department as permitted by section 30-20- 122(2), C.R.S. (2024).

between the local government and the processor, CAA Colorado will determine which entity should receive processing reimbursement. When needed, the agreement will include terms to address commodity revenue shares between local governments and MRFs.

- **Contracted Collection:** Where local government-contracted collected material is delivered to a participating processor, and the contract between the government and the contracted service provider includes processing fees and/or processing fees, CAA Colorado will determine which entity should receive the processing reimbursement.

- **Shared Container Collection – Mixed Commercial and Multifamily Routes:** Post-collection service providers will charge a processing fee to collectors that deliver materials from MFUs in mixed commercial/residential loads. The processing fee should be set to cover the net costs of service. Reimbursement for the processing costs will be between CAA Colorado and the service collector[27].

Data and Verification: Post-Collection

CAA Colorado will require MRFs and transfer facilities to report data such as the quantity of covered materials received, the costs of processing, residue rates, outgoing materials, commodity revenue received, and REM, to:

- Comply with the state law.

- Calculate Program performance.

- Identify opportunities for continuous improvement to increase the material recovery rate, reduce program costs, and promote best practices.

- Identify eligible costs.

- Calculate and verify reimbursement payments.

- Ensure that covered materials have been responsibly managed and have been delivered to REM.

- Meet requirements for environmentally sound management practices.

Details on data collection and storage is specified within the post-collection SOWs and submitted through CAA Colorado's service provider portal. Service providers will be initially required to separate performance and cost data for residential from commercial materials. Starting in 2028, CAA Colorado will be adding non-residential covered entities to the system, which will require additional data sorting.

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[27] This will eliminate the need for participating processors or collectors to estimate which portion of each mixed load delivered to a processor are from covered residential entities versus non-covered entities, which would result in a partial but unknown reduction in processing fees.

MRFs and transfer facilities that sign a service agreement for reimbursement will provide post-collection reporting that includes:

- Monthly reporting and back up for reimbursement claims, including certified scale weight tickets for inbound deliveries, sorted materials shipped to responsible markets, additional materials, rejected loads, and residuals.

- CAA Colorado's claims verification will include a review of commodity values to ensure that MRFs are marketing commodities to the highest and best use, and that realized commodity values are aligned with industry norms.

- Minimum monthly facility operations data reporting, including service disruptions, health and safety violations, and hazardous events from program deliveries.

- Amounts of contamination received.

- The number of incoming collection loads rejected due to contamination levels that exceed established limitations. Such loads should be photographed and sorted, and a charge for the applied to the collector. The cost will not be reimbursed by CAA Colorado. The collector who delivered the contaminated load will be responsible for these costs.

6.9 Calculation of Net Recycling Post-Collection Cost Reimbursements

Excerpt from the Act

25-17-705 (4)(j) Include reimbursement rates for one hundred percent of the net recycling services costs of the recycling services provided by service providers under the program consistent with the requirements of section 25-17-706. The reimbursement rates must: (I) Be calculated using an objective cost formula or formulas; (II) Incorporate the relevant cost information identified by the needs assessment pursuant to subsection (3)(a)(III) of this section; (III) Be calculated on a per unit basis such as per ton, per household, or other unit of measurement; and (IV) Take into account: (A) Regional recycling services costs; (B) Population density; (C) The number and types of households served; (D) The collection method used; (E) The revenue generated from covered materials; (F) The amount of inbound contamination and other factors affecting the quality of covered materials; and (G) Other demographic factors identified in the needs assessment pursuant to subsection (3)(a)(III) of this section.

MRF Reimbursement Cost Formula

The high-level components of MRF reimbursement and payments to service providers shall include:

- **Per Ton Processing Fees:** This fee is an agreed rate per ton of materials to the MRF over the agreement term. The agreement will include CPI escalators, inflation, and other external variables that will impact the fee. Depending on the materials processed and the method of

delivery, there may be more than one negotiated per-ton processing fee for each facility for the following materials:

- o MRL materials delivered as single or dual stream

- o Source-separated MRL materials

- o AML materials (single, dual or source-separated), for which per-ton processing fees may vary by material category

- **Commodity Revenues:** This includes 100 percent of the actual commodity sales for each covered material sold to verified REM.

- **Additional Cost Factors:** Service agreements will detail additional payment terms to reimburse investments that add new materials to the stream, ensure best commodities prices are received, increase efficiency, improve yield, or meet other Program objectives. Payments will be per ton or annual one-time cost, depending on the cost factor.

- **Non-REM Deductions:** To ensure that all tons are sent to verified REM, any tons sent to a non-verified REM[28] (excluding residue) will be deducted from net service payment. CAA will develop separate policy or guidance to address noncompliance issues with REM and how a REM may rectify issues from an audit.

Descriptions of each component and the objective cost formula for MRFs are below.

Per Ton Processing Fees: Processing fees are calculated by each MRF and are considered proprietary. There may be more than one negotiated per ton processing fee for a MRF. MRF processing fees generally comprise two components -- capital costs and operating costs. Capital costs are intended to recover costs such as site development, building construction, processing equipment, and rolling stock. Operating costs are intended to recover ongoing costs such as personnel costs, administrative costs, utilities and energy, maintenance, fuel, contamination management, and disposal. It is expected that each MRF will have different processing fees due to facility age, capacity, infrastructure, management approach, and investment needed to accept and sort MRL materials. Additionally, the processing fee will include a reasonable profit margin which will be negotiated. Processing Fees details include:

1. Proposed and contracted per ton processing fees with CAA Colorado are considered proprietary and subject to CAA Colorado's non-disclosure policies. However, as required by

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[28] CAA may authorize post-collection service providers to sell commodities to non-verified REM, without incurring a REM deduction, for a limited time and under certain agreed upon conditions. Agreements with service providers will outline both the process and specific conditions under which a post-collection processor may temporarily send materials to a non-REM without incurring deductions. For example, service agreements will include force majeure language to account for unforeseeable circumstances that may require commodities to go to a non-verified REM for a limited time due events such as natural disasters, pandemics and outbreaks, acts of war, or changes in laws.

the Act, CAA Colorado will include the ranges of rate schedules for reimbursement to service providers in the Annual Report.

2. CAA Colorado prefers a fair and open competitive procurement process with qualified MRFs, and reserves the right to decide, based on its own discretion, the method to arrive at per ton processing fee payments for a qualified MRF.

3. The per ton processing fee payment proposed for each MRF will be determined via:

   a. Best and final pricing in an evaluated process where more than one company is qualified for the work. Evaluation will not be based solely on pricing (i.e., other criteria will also be considered such as needed capacity, ability to process MRL materials, and acceptance and recovery of non–MRL materials). CAA Colorado does not propose to limit opportunities for MRFs.

   b. Individual negotiation with the MRF if sufficient competition (whether by transfer into a MRF or by direct delivery to a MRF) is not available in a given location.

4. Proposed MRF fees shall be based on the inbound quantities on a dollar per ton basis for MRL materials and any additional AML materials delivered monthly to the qualified MRF.

5. MRF per ton processing fees shall be calculated as follows:

   a. Proposed fees shall include the total cost per ton for processing a quantity of covered materials in a qualified MRF, with two components:

      i. The capital cost component shall recover capital utilization costs by covered materials from covered entities for such things as site development, building construction, processing equipment, yard tractor and rolling stock, and shall be calculated on a per ton basis.

      ii. The variable operating cost component shall recover ongoing costs such as rent, personnel costs, supervision, parts, utilities, internal and external freight, maintenance, fuel, contamination, insurance, taxes, utilities, management, disposal, and similar costs used in the processing of covered materials. The **total cost per ton** shall be the sum (i + ii) of capital cost and variable operating cost.

6. The per ton processing fee shall also include a profit component, intended to show the total profit component including any required corporate allocations.

7. The Total Processing Fee shall be the sum of MRF Costs and Profit:

(Total Cost Per Ton) + (Profit per Ton) = Per ton processing fee

8. Evaluation of fees in the procurement processes and any negotiations will consider both the profit, and the total processing fee expected.

9. MRF will likely have different processing fees due to facility age, capacity, infrastructure, management approach, and investment needed to accept and sort MRL materials. There will be an additional, reasonable margin to be negotiated.

10. CAA Colorado reserves the right to change the calculations at the conclusion of any contracted period.

Commodity Revenues:[29] These revenues include 100 percent of the actual commodity sales for each covered material sold each month to verified REM.

MRFs will apply 100 percent of actual commodity sales to the processing fee as an offset. The elements for calculating the blended actual commodity revenue offset will be:

- Total tons delivered to the MRF under the Program

- Percentage of each covered commodity collected

- Average price of commodity sold to REM in that month (Free on Board)

The blended actual commodity revenue per ton will be subtracted from the processing fee per ton to calculate the net price per ton.

> **(Processing fee) – (Blended commodity revenue / ton) = Net price per ton**

The net price per ton is then multiplied by the tons delivered to the MRF under the Program for the reimbursement period to calculate the base reimbursement.

> **(Net price / tons) x (Tons delivered to MRF from covered entities) = Base reimbursement**

Additional Cost Factors

Negotiated service agreements will include additional cost factors to encourage ongoing performance and material quality improvements, highest and best value for commodities, increased efficiency, improved sorting rates, expanding services, local end markets, highest and best use end markets, and other Program objectives. The cost factors will be on either a one-time fixed cost or an ongoing per ton basis. Cost factors will be incorporated in the form of per-ton incentives or penalties. The table below details examples of cost factors that will be included in the final negotiated rates.

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[29] CAA Colorado will consider existing revenue share agreements that may be under contract between local governments and MRFs in the service agreements.

Table 19: Reimbursement Cost Factors

Cost Factor (Cf) Examples	Incentive Basis
Cf_1. Adding materials to the stream (MRL and AML) investment	$ / ton for incoming materials processed (covered entities)
Cf_2. Preferred end market (highest / best use, circular local)	$/ ton sent to preferred end market
Cf_3. Target sorting rates (% by material category)	$ / ton of target material
Cf_4. Incoming contamination	$ / ton incentive to process
Cf_5. Outgoing missed recyclables (e.g. target of X% total)	$ / ton for incoming materials processed (covered entities)
Cf_6. Worker safety / training	One-time / year
Cf_7. Public education / tours	One-time / year
Cf_8. Marketing Fee	A fixed fee rate (%) of the blended revenue earned from the sale of covered materials from covered entities in the reimbursement period. The fee is paid to the Service Provider to ensure the best prices are received from REM, fee provides an upside benefit to processors to secure higher commodity revenues.
Cf_9. Others cost factors as needed	Will depend on cost factor and Program aims

The additional cost factors will be applied to the appropriate tonnages and added to the base reimbursement. An example of how three additional cost factors would be applied is as follows:

$((Cf_1)$ x (Total Tons Delivered to the MRF under the Program)) + $((Cf_2)$ x (tons sent to preferred end market)) + ((Blended commodity revenue/ton) x (tons for payment) x $(Cf_8))$ = Additional Cost Factor expressed as $

The additional cost factor is then added to the base reimbursement.

(Base reimbursement) + (Additional cost factor) = Reimbursement

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Non–REM Deductions: To ensure that all tons are sent to REM, any tons sent to a non–verified REM[30] (excluding residue) will be multiplied by the per ton processing fee and deducted from reimbursement to calculate the final net service payment for the reimbursement period.

(Tons sent to nonverified REM) x (Processing Fee) = REM deduction

(Net Reimbursement) – (REM deduction) = Net Service Payment

Secondary Processing

CAA Colorado reports on recycling when material is sorted at a MRF and becomes a commodity output. The specific commodity value is assessed at the point of sale to the end market. CAA Colorado's MRF reimbursement cost formula utilizes the commodity value realized by the MRF for the reimbursement period to determine net service cost. In some cases, this commodity value might include the costs of secondary processing that occurs further down the recycling value chain. CAA Colorado will ensure to add measures to avoid double payments. In many cases, CAA Colorado will reimburse the MRFs for this cost through the commodity revenue step in the reimbursement cost formula. Materials sent to a secondary processor prior to an end market are still subject to REM verification.

Transfer Facility Reimbursement Cost Formula

For transfer facilities, CAA Colorado will establish services agreements to reimburse per ton costs associated with receipt, consolidation, and transport of covered materials. Eligible costs will include eligible operating costs, capital costs, and debt service, and will be used to calculate an agreed–upon per ton transfer fee for processed MRL and AML materials. In addition to a per ton processing fee, service agreements will include a transportation cost element, expressed as dollars per ton per

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[30] CAA recognizes that factors outside of the control of a MRF may require that commodities are temporarily sold to a non–REM. Service agreements will include force majeure language to account for unforeseeable circumstances that may require commodities to go to a non–verified REM for a limited time. Service agreements will include the temporary conditions under which a processor is permitted to send materials to a non–verified REM without incurring deductions in reimbursement payments.

mile ($/ton/mile). Net service costs will be less earned commodity revenues for covered MRL and AML materials that are sent directly to a verified REM by the transfer station operator.

((Per ton Fee x Tons AML and MRL Received) + (Tons to Participating MRFs x Transportation Cost/ton/mile x miles traveled)) – (Commodity Revenue) = Net Reimbursement

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6.10 Reimbursement Rate Schedule – Processing

Services agreement will be individually negotiated with processors. The reimbursement rates will be based on actual costs and negotiated service agreement terms, and will vary by facility location, services, equipment, prevailing wages, commodity values, and other factors. These approaches are summarized in the table below describing processing reimbursement rate schedules.

Table 20: Post–Collection Reimbursement Rate Schedule

Processing Type	Direct Reimbursement Recipient	Basis for Reimbursement	Reimbursement Unit
Transfer facility	Transfer Station Owner	Negotiated receiving/ consolidation price and transportation price	$ / ton $ / ton / mile
MRF (includes Push and Bale)	MRF Owner	Negotiated processing and transportation price	$ / ton $ / ton / mile

Process for Evaluation and Revision: Post–Collection

Excerpt from the Act

25-17-705 (4)(k) Describe the process to evaluate and revise the objective cost formulas as necessary and using documented costs. If the plan proposal includes more than one objective cost formula for recycling services, the plan proposal must describe the conditions under which each formula will be applied.

CAA Colorado will periodically undertake post-collection cost surveys and analysis to assess service agreement costs and incentives and to compare post-collection costs across Colorado. Cost studies will be undertaken at least once per five-year Program period and may be undertaken more frequently if needed. Cost evaluations may be applied under the following conditions:

- At the start or end of established service agreements for post-collection services.

- Where a local government has or enters into an agreement for contracted collection and post-collection services.

- To improve reimbursement calculations.

CAA Colorado will use these studies to evaluate the cost effectiveness of the post-collection service reimbursements. This information will also be used to inform reimbursement when establishing new service agreements and reevaluating the objective cost formulas for post-collection services. The conditions under which the objective cost formulas may be revised include, but are not limited to:

- Market related issues that jeopardize the outcomes sought in the program plan
- Legislative policy or rulemaking changes
- Recommendations provided by CDPHE

CAA Colorado reimbursement service agreements will be multi-year contracts that are intended to provide price stability and reliability for service providers. During the term of the service agreements, CAA Colorado and service providers will be collaborating to expand infrastructure and efficiencies that can influence costs. Service agreements will be structured to be forward-looking to accommodate for service and infrastructure expansion. Agreements will include agreed-upon conditions for when processing fee adjustments are needed.

During the development of future year's budgets, CAA Colorado will assess the performance of the post-collection system in relation to collection targets and convenience standards. Based on this assessment, CAA Colorado will work with service providers to evaluate the need for additional transfer facilities and MRFs for reimbursement.

Service Expansion and Continuous Improvement: Post-Collection

Collaboration with post-collection service providers to expand recycling services and continuously improve are critical to achieve the Act's objectives. Service agreements for post-collection are intended to provide predictability and stability to accommodate service expansion and addition of MRL materials. Services agreements will include language for service expansion, and SOWs will be structured for both existing services and service expansion. Over time, CAA Colorado desires to enter into negotiated agreements with MRFs and transfer facilities to cover processing fees for all collection models, including open market, contracted collection, and local government collection.

Agreement terms may include addressing the following aspects of service expansion:

- Providing advance notification of proposed changes to post-collection services.
- Agreement for the treatment of costs from service provider decisions to implement or expand services for non-covered materials and non-covered entities.
- Coordination with CAA Colorado when new materials are planned to be added to MRL or AML, and where transfer or processing operations may be impacted.

- CAA Colorado assistance with EPR language for processing contracts approaching expiration.

- Adjustments to rates based on annual reviews and studies of collection reimbursement costs across Colorado.

- Use of confidential data reported to CAA Colorado by the service provider.

6.11 Reimbursement to CDPHE

CAA Colorado is responsible for reimbursing CDPHE for the reasonable costs incurred in administering, implementing, and enforcing the Program. Additionally, CAA Colorado must reimburse CDPHE for reasonable costs of the EPR Advisory Board. Advisory Board members will be reimbursed at a rate consistent with other boards and commissions created within CDPHE for necessary travel within the state and other reasonable expenses incurred in the performance of their official duties.

CDPHE will notify CAA Colorado on or before June 30, 2026, of the costs incurred in implementing, administering, and enforcing the Program between the effective date of the Act and the notification date. By June 30 of each year after 2026, CDPHE shall submit notification to CAA Colorado of the reasonable costs incurred in administration, implementation, and enforcement during the preceding year. Upon receipt and verification of CDPHE's cost accounting, CAA Colorado shall reimburse CDPHE for its costs. CAA Colorado will work with any other PROs to share CDPHE costs based on mutually agreeable terms.

6.12 Accountability Mechanisms

Funding provided to service providers will be accompanied by accountability mechanisms to ensure that funding is allocated to its intended purpose. CAA Colorado will continue to consult with service providers regarding the accountability reporting and conditions associated with the provision of reimbursement funding and the details of the accountability processes will be provided in the RFR terms and conditions.

7 Operations Plan: Material Strategy

This chapter will:

- Describe the covered materials included in the Program.

- Define MRL and AML.

- Present the five-year Program goal for minimum collection and recycling rates, which include targets for the minimum collection rates, and minimum recycling rates for certain types of covered materials (including paper products, glass, metal, and plastic) that CAA Colorado will strive to meet by January 1, 2030.

7.1 Covered Materials

Excerpt from the Act
25-17-705 (4)(f) Include a comprehensive list of the covered materials included in the program in accordance with this part 7.

CAA Colorado will define a comprehensive list of packaging and paper product categories in the Program, referred to as the covered materials list. It was informed by the Needs Assessment and consultation with interested parties.

The covered materials list informs the list of producer reporting categories (see Table 33). Reporting categories are used by producers when reporting annual data on their supply of covered materials in Colorado and are the basis for dues.

Notably, the covered materials list exempts the following packaging as defined in the Act[31]:

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[31] Additional information on exemptions is included in CAA's producer guidance available on the producer portal including examples.

- Long-term storage of durable products

- Paper products that, once used, are unsafe or unsanitary to handle

- Printed paper used to distribute vital documents that are required by law to be provided in paper form

- Bound books

- Packaging used exclusively in industrial or manufacturing processes

- Packaging material used to contain a product that is regulated under federal law as a drug, medical device, or dietary supplement

- Animal biologics, including vaccines, bacterins, antisera, diagnostic kits, and other products of biological origin

- Insecticide, fungicide, and rodenticide

- Poison prevention packaging

- Infant formula

- Medical food

- Fortified nutritional supplements

- Beverage containers subject to a deposit return system

- Paint containers and other packaging subject to a paint stewardship program

- Packaging used to contain a portable electronic device offered for sale as a refurbished product

- Print publications for news and current events

- Any other material the Solid and Hazardous Waste Commission determines by rule not to be a covered material

Additionally, materials not managed by CAA, but included on the Lubricants Packaging Management Association (LMPA) powered by Interchange 360 "Applicable Products List" will be covered under a coordination agreement between CAA and LPMA pursuant to Colorado statute/regulation. A separate Individual Program Plan (IPP) has been submitted by LPMA to the Colorado Department of Public Health and Environment (CDPHE) outlining how producers shall register and how the materials will be handled. As such, CDPHE has informed CAA that producers of petroleum and automotive products must register directly with LPMA and should report their primary packaging associated with products on the LPMA Applicable Product List to LPMA. Any secondary packaging or paper products associated with these containers supplied to covered entities should be reported to CAA.

Note, if there is a change in the scope of LPMA's Individual Program Plan (IPP) or if another IPP is approved, the list of covered materials that CAA Colorado provides compliance for may be altered based on the covered materials they may be accepting.

7.2 Minimum Recyclables List and Additional Materials List

Excerpt from the Act
25-17-705 (4)(o) Include the minimum recyclable list established in accordance with section 25-17-706 (1)(a);

Since the covered materials list represents the full scope of packaging materials under this Program, additional analysis was required to identify the availability of recycling services, the collection and processing infrastructure, and end markets for each covered material. CAA Colorado completed an analysis as part of the Needs Assessment but also received input from the consultation process, the advisory board, and subject matter experts.

The legislation requires CAA Colorado to assess current conditions in Colorado including the availability of recycling services, recycling collection and processing infrastructure, and recycling end markets for covered materials, to develop both:

- The MRL, which is the list of covered materials that must be collected statewide in a manner that is as convenient as the collection of solid waste.

- The AML, which is the list of covered materials that may be collected in different geographic areas through curbside services, drop-off centers, or other means.

A re-evaluation of these lists will be undertaken on an annual basis.

Needs Assessment Approach to MRL and AML

The Needs Assessment gathered data on accepted materials to understand the extent to which covered materials are collected in Colorado, with criteria based on feedback from the Advisory Board. Finally, each material on the list was evaluated on the following criteria:

- Availability of recycling services

- Recycling collection and processing infrastructure

- Sortability of materials at MRFs

- Recycling end markets

- Challenges to the recycling process

Based on the above, MRL and AML are shown in the tables below. Per the convenience standard and in geographic areas where solid waste collection is curbside, CAA Colorado proposes to collect MRL material using curbside collection. In areas where solid waste collection is drop-off, CAA proposes MRL materials collection via drop-off. Additionally, the Program includes a table of covered materials that are on neither the MRL nor the AML list.

CAA Colorado's Education and Outreach efforts will further define each packaging type and provide examples to help differentiate the materials on each list.

Table 21: Minimum Recyclables List and Collection Method

Material Class	Covered Material Category	Collection Method Based on Solid Waste Collection
Paper	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 (e.g., brown Kraft or unprinted packaging paper)	Curbside
	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 Service Ware (e.g., egg cartons, other protective packaging)	Curbside
	Gable-Top	Curbside
	Aseptic Cartons	Curbside
	Non-Metalized Gift Wrap	Curbside
Rigid Plastics	Clear Polyethylene Terephthalate (PET) Bottles, Jars, Jugs, and Lids (including Transparent Green or Blue)	Curbside

	Clear PET Thermoform Containers (including Transparent Green or Blue) (e.g., clamshell packaging for salads and other food and non-food products. Other thermoformed PET containers for berries and other fruits and vegetables, muffins, egg cartons)	Curbside
	Natural High-density Polyethylene (HDPE) Bottles, Jars, and Jugs	Curbside
	Colored HDPE Bottles, Jars, and Jugs	Curbside
	Other Rigid Polyethylene (PE) Packaging (e.g., ice cream / butter containers) Except Pails and Lids and Squeezable	Curbside
	Polypropylene (PP) Rigid Packaging Except Pails and Lids (e.g., deli containers, cleaning products)	Curbside
	Large HDPE and PP Pails and Lids (e.g., cat litter)	Curbside
Metal	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
	Metal – Small Format (e.g., metal closures, staples, and other packaging elements)	Curbside
Glass	Clear or Colored Glass	Curbside or Drop-off

Table 22: Additional Materials List and Solid Waste Collection Methods Based on Collection of Solid Waste in a Geographic Area

Material Class	Covered Material Category	Collection Method
Paper	Paper – Small Format	Curbside, Drop off, or Other Means
	Molded Pulp Food Service Ware (e.g., take-out "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)	Curbside, Drop off, or Other Means
	Paper cans (spiral-wound containers) with steel ends	Curbside, Drop off, or Other Means
Rigid Plastics	Colored Opaque PET Bottles, Jars and Jugs	Curbside, Drop off, or Other Means
	Colored Opaque PET Thermoform Containers (e.g., blue food tray, white yoghurt tub)	Curbside, Drop off, or Other Means
	PET (#1) – Other Rigid Items	Curbside, Drop off, or Other Means
	PE Squeeze Tubes (e.g., toothpaste, lotions/sunscreens)	Curbside, Drop off, or Other Means
	LDPE (#4) – Bottles, Jugs, and Jars	Curbside, Drop off, or Other Means
	LDPE (#4) – Other Rigid Items	Curbside, Drop off, or Other Means
	HDPE 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

	White Expanded Polystyrene (e.g., television or electronics packaging, takeout food containers and cups)	Drop off, or Other Means
Flexible Plastics	LDPE/HDPE Film (e.g., monoPE recycle compatible pouches)	Curbside, Drop off, or Other Means
Metal	Other Aluminum Packaging (Foil and Foil Trays)	Curbside, Drop off, or Other Means
	Other Metal Packaging (e.g., clips, strapping)	Curbside, Drop off, or Other Means

Table 23: Covered Materials on Neither the MRL nor AML

Material Class	Covered Material Category	Collection Method
Compostable	Flexible plastic (certified compostable)	Not Collected
	Paper (certified compostable)	Not Collected
	Rigid plastic (certified compostable)	Not Collected
Flexible Plastics	Multi-material Films, Non-mono material Pouches, Other Flexible Packaging	Not Collected
	PET Film	Not Collected
	PLA, PHA, PHB – Plastic Film (not-certified compostable)	Not Collected
	PP Film (includes monoPP recycle compatible pouches)	Not Collected
	PP Woven Film (e.g., pet food bags)	Not Collected
	PVC Film (e.g., linen packaging, labels)	Not Collected
Glass	Ceramic, Porcelain, Pyrex and Other Glass–Like Material	Not Collected
Other	Antifreeze Containers	Not Collected
	Motor Oil Containers	Not Collected
	Paint Containers	Not Collected
	Pesticide Containers	Not Collected
	Plastic – Small Format	Not Collected
	Pressurized Cylinders (not including aerosols)	Not Collected
	Rubber Packaging (e.g., stopper)	Not Collected

	Solvent Containers	Not Collected
	Textile Packaging (e.g., cloth bags, burlap sacks)	Not Collected
	Wood Packaging (e.g., clementine box)	Not Collected
Paper	Paper – Small Format	Not Collected
	Wax Coated Corrugated Cardboard	Not Collected
Rigid Plastics	Colored Expanded PS (e.g., meat trays, egg cartons)	Not Collected
	Non-Expanded PS (e.g., egg cartons, clamshell containers, cups/plates/bowls, yogurt containers, clear rigid trays)	Not Collected
	PLA, PHA, PHB (non-certified compostable)	Not Collected
	PS Nursery Containers (e.g., pots, trays, etc.)	Not Collected
	PVC (#3) – Rigid Items	Not Collected

CAA Colorado aims to transition materials from the AML to MRL as the overall recycling system improves (i.e., sorting equipment or end markets become available), as further detailed in the *System Expansion* Chapter. Updates to MRL may be submitted in the Annual Report and through consultation with the advisory board. It will also look to improve conditions for those materials that may not be on MRL or AML so that they can be collected and recycled in the State.

MRL and AML Collection Approach

As Colorado's collection and processing infrastructure must be ready to accept MRL materials, existing service providers will play an integral role. CAA Colorado's education and outreach approach will help the public differentiate covered materials on MRL and AML. This approach is further detailed in the *Operations Plan: Education and Outreach* Chapter.

CAA Colorado will undertake a three-phase approach to collection and processing of MRL and AML that parallels the implementation of collection service, as follows:

Phase 1 – Prior to Implementation of Program (2025 and early 2026)

- As part of the service procurement process, CAA Colorado will request information from tribal nations, local governments and collection and post-collection service providers to assess their ability to manage MRL and AML materials. CAA Colorado will perform financial and technical reviews to qualify service providers for reimbursement. This qualification step is described in detail in the *Operations Plan: Service Provider Reimbursement* Chapter.

- CAA Colorado will undertake education and outreach with service providers, tribal nations, local governments, and processors on MRL and AML, the timing of service agreements for reimbursement, and expectations for acceptance and sorting.

Phase 2 – Implementation of Program (within six months of CDPHE's Program approval)

- Upon Program approval, CAA Colorado will begin to execute service agreements for reimbursement of collection and post-collections services. SOWs will include conditions where local recycling acceptance lists are different from MRL, treatment for these conditions, and plans to transition these materials to MRL.

CAA Colorado will begin to execute service agreements for reimbursement of collection and post-collection services of AML materials while educating residents, service providers, tribal nations, and local governments about MRL materials and curbside collection.

- CAA Colorado will establish a process for how a material can transition from AML to MRL, and for the education of residents on how to recycle AML materials.

Phase 3 – Ongoing Service and Service Expansion

- CAA Colorado will collaborate with processors to process MRL and specific AML materials.

- CAA Colorado will begin implementing a phased approach to transition packaging from AML to MRL. This approach is described in the *System Expansion* Chapter and *AML Pathways to MRL* Appendix which includes market development.

MRL includes three materials – glass, steel aerosol containers, and aluminum aerosol containers – that will be collected via curbside or drop-off collection.

- Glass: CAA Colorado will reimburse glass collection through existing collection methods and consider expanding drop-off and other programs, meaning that residential and non-residential glass collection will be through both curbside and drop-off. CAA Colorado will also work with service providers to provide collection of source-separated glass at existing and new drop-off locations. This approach also includes investments in equipment to improve the efficiency of glass recovery at MRFs.

- Aerosol Containers (aluminum, steel): CAA Colorado will reimburse collection of aerosols through existing methods and consider reimbursement of expanded collection through drop-off and other programs, meaning that residential and non-residential aerosols collection will be through both curbside and drop-off. For expansion of residential service, CAA Colorado will consider including aluminum and steel aerosol containers in new curbside collection services. CAA Colorado will also work with service providers to provide collection of source-separated aerosol containers at existing and new drop-off locations.

Continuous Improvement

The Act requires CAA Colorado to continually increase the minimum collection rates and recycling rates, including after January 1, 2035. The Needs Assessment and Program will be updated every five years, and CAA Colorado will evaluate the MRL annually and reassess collection, recycling, and minimum PCR rates by applying the following principles:

- Reviewing targets and MRL annually, including seeking ongoing improvement.

- Seeking to ensure the efficacy of different tools to achieve more effectiveness and efficiency.

- Transparency through seeking to track and publicly report on Program successes and areas needing improvement.

8 Operations Plan: Education and Outreach

> **Excerpt from the Act**
>
> CRS 25-17-707 (1) the organization shall develop and implement a statewide education and outreach program that is designed to increase the recycling and reuse of covered materials and includes education and outreach on: (a) proper end-of-life management of covered materials; (b) the location and availability of recycling services under the program; and (c) how to prevent littering in the process of providing recycling services for covered materials.
>
> CRS 25-17-707 (2) the education and outreach program must, at a minimum: (a) provide clear and concise recycling instructions that are consistent statewide and accessible for all demographic groups; (b) coordinate with existing recycling education materials and services provided throughout the state; and (c) be designed to help the state achieve the minimum collection rate and minimum recycling rate targets established in the final plan under section 25-17-705 (4)(p) and reduce levels and impacts of inbound contamination from covered materials at materials recovery facilities and compost facilities.
>
> CRS 25-17-709 (2)(a)(IX) a summary of the education and outreach efforts implemented in accordance with section 25-17-707, including: (A) samples of any materials distributed; and (B) a description of the methodology used and the results of the evaluation conducted pursuant to section 25-17-707 (4);

This chapter describes how CAA Colorado intends to design and implement an education and outreach plan in support of achieving the following Program goals:

- Increase access to recycling services to divert as much packaging from the landfill as possible.
- Increase recycling service participation to meet or exceed the minimum collection rate target.
- Reduce the level of contamination to meet or exceed the minimum recycling rate target.
- Increase the availability and encourage the use of reusable and refillable packaging.
- Increase participation in the Program.
- Inform proper end-of-life management of covered materials including compostable products.
- Raise public awareness on the location and availability of recycling services.
- Preventing litter during the recycling process.

The education and outreach plan will target the public, local government and participating tribal nations, service providers, producers, and other actors in the circular economy.

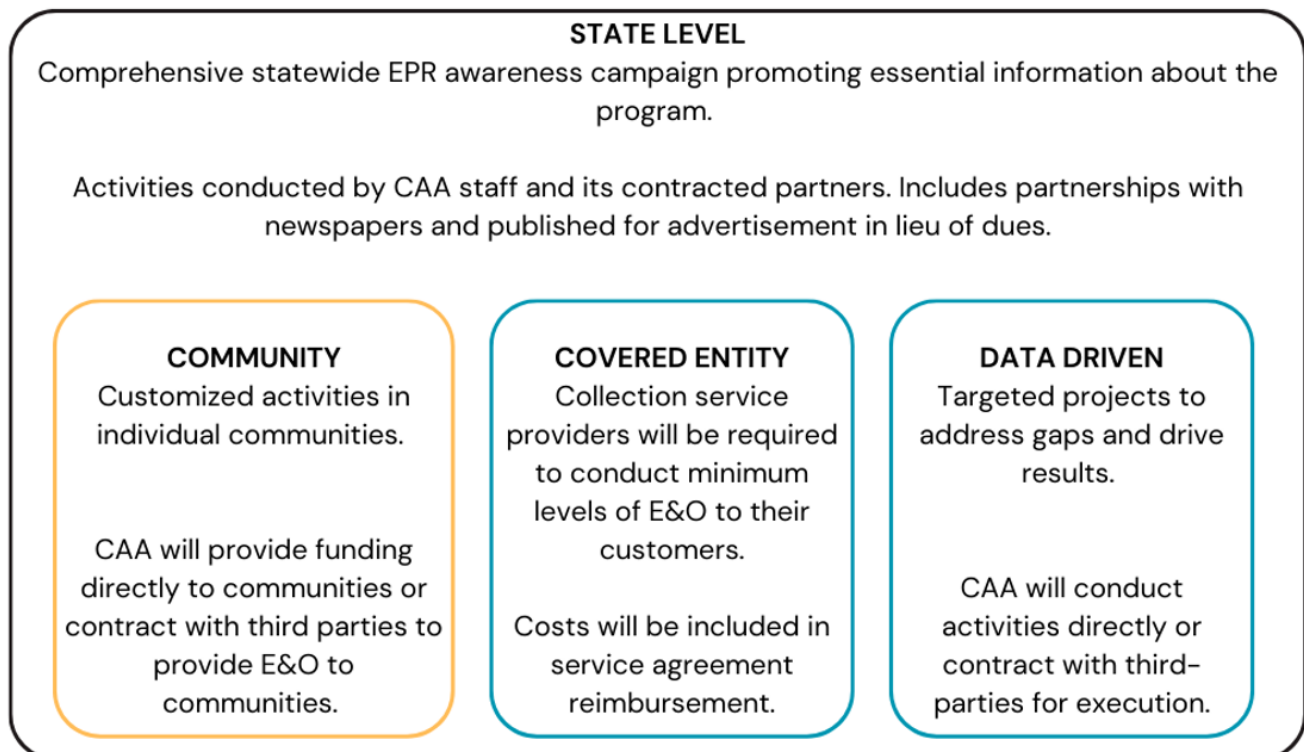## 8.1 General Approach to Education and Outreach

Leveraging the information from the Colorado Needs Assessment and consultation process, CAA Colorado will use the following approach to develop a comprehensive and inclusive education and outreach plan:

- Create widespread awareness of the plan among the public, producers, collection and post-collection service providers to increase Program participation and recycling rates.

- Create widespread awareness of recycling, composting, reuse/refill programs and other proper end-of-life management methods for covered materials among homeowners, renters, seasonal residents, commercial tenants and tourists – with emphasis given to MRL and AML materials.

- Provide public information on the location and availability of recycling, compost, and reuse/refill services, including curbside service, local drop-off centers, and supplemental collection programs.

- Create and deploy consistent recycling instructions and messaging that are simple to understand, accessible and actionable. Messaging will not only explain what is recyclable and how to recycle but also emphasize why it is beneficial.

- Inform the public about how to prevent litter during collection, building on existing initiatives and best practices at the local, state, and national level.

- Reduce contamination in inbound materials by emphasizing to the public the importance of properly preparing recyclable and compostable materials.

- Share education and outreach materials and tools with organizations whose mission includes public education and outreach, and which continue to be engaged with the public and circular economy participants to encourage a more harmonized, consistent message.

- Recognizing the value of collective education and outreach activities, CAA Colorado will collaborate with collection service providers, tribal nations, local governments, and community-based organizations to support the continued growth and success of existing local initiatives. For areas of Colorado that could benefit from enhanced education and outreach, CAA Colorado will work with these groups to advise on best practices and explore opportunities for new initiatives.

- Ensure that education and outreach materials will be accessible, culturally appropriate, and available in multiple languages for each targeted demographic group.

- Ensure citizens of Colorado have transparency into the recycling system and confidence that the materials they are taking the time to recycle, compost, or reuse/refill are being managed properly. CAA Colorado will engage with the public to continuously improve the recycling system.

- Collaborate with local organizations to develop a compelling narrative around the importance of recycling, composting, and reuse/refill and engage in dynamic storytelling to ensure messaging is relevant and relatable at the local and regional level.

Implementation Approach: CAA Colorado will collaborate with collection service providers, communities, CDPHE, the advisory board, and regional and local education and outreach providers in the design and implementation of our education and outreach program. CAA Colorado will draw upon a dedicated education and outreach budget to directly fund activities and will incorporate funding for education and outreach in service agreement reimbursements with collection service providers. The implementation encompasses specific programs at the state, community and individual household level, as well as data-driven projects aimed at improving waste diversion practices among targeted groups. Figure 5 illustrates CAA Colorado's Education and Outreach approach.

Figure 5: Education and Outreach Approach

STATE LEVEL
Comprehensive statewide EPR awareness campaign promoting essential information about the program.

Activities conducted by CAA staff and its contracted partners. Includes partnerships with newspapers and published for advertisement in lieu of dues.

COMMUNITY
Customized activities in individual communities.

CAA will provide funding directly to communities or contract with third parties to provide E&O to communities.

COVERED ENTITY
Collection service providers will be required to conduct minimum levels of E&O to their customers.

Costs will be included in service agreement reimbursement.

DATA DRIVEN
Targeted projects to address gaps and drive results.

CAA will conduct activities directly or contract with third-parties for execution.

State Level

CAA Colorado staff and contracted providers will develop and launch a statewide EPR awareness campaign. Activities may include the development and distribution of customizable messaging materials, photo libraries, partnerships with newspapers and publishers for advertisements in lieu of dues, and collateral aimed at increasing overall Program awareness. The campaign will cover essential information about the Program, including what can be recycled, how to participate,

registration for producers, and producer guidance. It will also promote Program goals and progress through the Annual Reports. Specific activities may include:

- Education and outreach resources posted on website for participating service providers to access materials.
- Publishing a list of participating collectors for covered entities.
- Conducting education and outreach to collection service providers on entering service agreements for reimbursement.
- Multi-media campaign.
- Other activities, as needed, to be developed with input from the advisory board and local providers.

Funding: State-level activities will be managed directly by CAA Colorado with the potential of entering into agreements with organizations that have experience in facilitating large education and outreach campaigns. CAA Colorado will not reimburse collection service providers for the state-level activities, unless contracted by CAA Colorado.

Community Level

CAA Colorado will tailor education and outreach activities to individual communities (counties, cities, towns, or tribal nations) providing customizable materials, messaging, and resources to support effective local public education and outreach. Community-level activities may include:

- Direct mailers to households.
- CAA Colorado or provider attendance and participation at community events.
- Presentations at public meetings.
- Direct outreach to covered entities.
- CAA Colorado or provider attendance and participation at school events.
- Train-the-trainer sessions to equip individuals with the knowledge, tools, and resources necessary to train others to correctly recycle and compost.
- Use of community based social marketing (CBSM) by engaging with local groups to encourage positive recycling behaviors. CBSM emphasizes understanding the barriers and motivations that influence people's actions and works to overcome those obstacles through targeted, community-specific interventions.
- Engaging local and regional community-based organizations to develop and share relevant and relatable messaging via dynamic storytelling.
- Other activities described in the *Operations Plan: Education and Outreach* Chapter.

These community-level activities complement statewide efforts and additional education and outreach provided by recycling collectors under service agreements. All community providers (contractors, local governments, other service providers) will have access to these education and outreach materials and support.

Funding: Colorado communities and tribal nations have three options to fund and execute education and outreach activities:

1. **Service Agreements:** Communities may choose to enter into education and outreach service agreements with CAA Colorado. These agreements will outline approved activities, required data tracking and reporting, and payment terms. Education and outreach payments will be fixed per household for covered entities with a minimum flat rate for smaller communities. Communities may sub-contract education and outreach activities to local sub-contractors.

2. **Joint Service Agreements:** If desired, communities can choose to work together to conduct local education and outreach under a joint service agreement, which would be indicated through the RFR process. Under this model, a lead county or city would conduct all joint education and outreach activities – if, for example, it has existing staff and resources to undertake education and outreach – with the other participating communities waiving their payments and allowing the lead to collect the per household payments. The lead would be responsible for tracking and reporting required data and impacts. CAA Colorado would require an MOU or other documentation from participating communities prior to approving a joint service agreement.

3. **CAA Colorado–Provided Education and Outreach:** For communities that opt out of service agreements or chose not to respond to the community RFR, CAA Colorado will work through local or regional third-party providers to conduct local education and outreach on their behalf. CAA Colorado will work with local providers to maximize benefits, reduce burdens on communities that may not have in-house staff or resources, and lower overall education and outreach costs. When seeking contracts with vendors to assist with education and outreach projects, CAA Colorado will consider locally owned nonprofits, women-, minority- or veteran-owned businesses, and small disadvantaged businesses as defined by the US Small Business Administration.

Covered Entity Level

Collection service providers entering into service agreements with CAA Colorado will be required to conduct a minimum level of education and outreach. CAA Colorado will provide customizable messaging, product templates, images, FAQs, and other resources to collection service providers for education and outreach activities.

Funding: The costs associated with the base level education and outreach will be included in the service reimbursement cost formula. Specific activities, data collection, and reporting will be detailed in the service agreement terms.

Data Driven Projects

CAA Colorado may conduct targeted, data-informed education and outreach projects aimed at enhancing reuse/refill, recycling and composting among specific covered entities segments, populations, regions, or cities. As these activities depend on initial data on access, participation, and program metrics, no special projects are anticipated in the first Program year.

Funding: These projects will be carried out by CAA Colorado staff or contracted education and outreach service providers. When seeking contracts with vendors to assist with education and outreach projects, CAA Colorado will consider locally owned nonprofits, women-, minority- or veteran-owned businesses, and small disadvantaged businesses as defined by the US Small Business Administration.

8.2 Engagement Approach

In implementing the education and outreach plan, CAA Colorado will prioritize clear and consistent engagement with all interested parties and will adopt an approach of continuous improvement, recognizing the dynamic and complex nature of Colorado's materials management system.

a. **Develop and provide key messaging, customizable templates, an image library, and implementation guidance for use by providers.**

It is imperative that public recycling instructions and information are clear, consistent, and actionable. Such information and instructions include:

- Definition of EPR and its benefits

- An explanation of recycling, compost, and reuse/refill services

- Where recyclable materials are accepted (e.g., MRL, AML)

- How to sign up for or access services

- Instructions for preparing materials for recycling and composting including reducing contamination

- Information on litter prevention and PCR

CAA Colorado can serve as a resource library for a wide range of education and outreach tools and best practices that will be made available to providers. CAA Colorado will be intentional in its approach to ensure regional, cultural, and language needs are met. To boost public familiarity and trust, CAA Colorado will explore the possibility of creating a state-wide brand for education and outreach materials. CAA Colorado will also explore the possibility of creating a website to provide easy access to resources in electronic format, which would be regularly updated. CAA Colorado will consult with the Colorado advisory board to gather feedback on the design and content of any educational materials produced by CAA Colorado. CAA Colorado will ensure all resources are accessible and available in multiple languages.

b. **Leverage existing collateral materials where possible.**

CAA Colorado will continually seek out existing education and outreach materials and methods to determine how they can be leveraged to support education and outreach activities. CAA Colorado will also note where multilingual materials are deployed and how education and outreach materials can be improved and harmonized. CAA Colorado will also

determine which existing communication channels are effective based on cultural and regional needs.

c. **Engage with collection service providers to provide education and outreach in a mutually agreed upon and equitable manner.**

It is inevitable that there will be periodic changes to elements such as material lists, recycling instructions, and reuse/refill and composting programs. The effects of these changes will likely be experienced unevenly across the state, allowing education and outreach to play a critical role in clarifying these changes. This may require the development of education-related contract specifications for inclusion in collection service provider contracts. Collector service agreement terms will define and reimburse for a minimum education and outreach standard to serviced covered entities. The agreement terms may also reflect reimbursement for the cost of updating educational materials and deploying outreach campaigns to inform covered entities of any changes.

d. **Consult and collaborate with community-based and other organizations providing education on the development and distribution of education and outreach materials.**

These organizations play a key role in the success of CAA Colorado's education and outreach plan and are particularly well suited to support adapting messaging to reflect regional, cultural, and other differences. Many of these organizations already have community relationships which can be leveraged to improve recycling outcomes. Property management, rental and tourism organizations can provide their audiences with information about recycling. Environmental advocacy organizations can be tapped to ensure that historically underserved communities receive appropriate education and outreach activities to build trust among these communities. The advisory board can provide useful insight and perspective that can help guide CAA Colorado's implementation approach.

e. **Use a broad range of platforms and channels to effectively reach all target audiences.**

Communication channels and platforms may include:

- Websites: CAA Colorado will explore how best to leverage its online presence as a source of information for the public and provider organizations.

- Apps and website widgets: This may include recycling collection reminders as well as waste sort and gamification apps, and podcasts.

- Radio and television: This may include advertising and public service announcements.

- Newspapers and magazine advertising: Publishers with a subscription base in Colorado can provide CAA Colorado with in-kind advertising in their print and online publications in lieu of paying producer dues.

- Out-of-home media: This may include digital or print messaging on bus shelters and highway billboards.

- Print collateral: CAA Colorado and its providers will develop a template library that could include pamphlets, post cards, stickers, calendars, handouts, signs, cart tags (including "oops" tags that inform residents of items that have been placed in the recycling bin that do not belong), magnets, and door tags. This may also include boilerplate text for informative and motivational messaging that can be included in municipal newsletters, newspapers and bill inserts.

- Social media: CAA Colorado and its providers will explore how best to leverage social media accounts, content creators, influencers, sample messaging, and digital materials.

- In-person engagement: This may include attending public meetings and events, organizing workshops to train individuals who can train others to recycle and compost correctly, and soliciting interviews with reporters for broadcast on radio, television, and print/digital news outlets.

- Targeted approaches: This may include focusing on specific entities that can create greater public awareness through their existing networks, leadership, interactions, or activities. For example, the food service industry to target messaging on compostable food service packaging, property management companies to target HOAs, short term rental agencies to target seasonal visitors, or multiple other examples.

- Storytelling: Stories are effective ways of conveying information and can simplify the complexity of EPR. CAA Colorado will incorporate dynamic storytelling to make the education and outreach plan more resonant and effective by providing:

  o Emotional Connection: Stories will be used to promote emotional engagement and foster trust in the recycling system.

  o Memorability: People are more likely to remember stories than facts or figures.

  o Identity: Storytelling will be used to convey the benefit of recycling and shape how consumers perceive the Program.

  o Engagement: Compelling stories will be used to capture attention and keep audiences engaged, especially important in an era of information overload.

  o Content Versatility: The stories can be adapted across various channels, including social media, blogs, videos, and advertisements, maximizing their impact.

  o Cultural Relevance: Engaging with current events or cultural trends through storytelling will be used to make recycling messages more relevant and timelier to a diverse audience.

f. **Develop education and outreach materials to maximize accessibility for all**.

CAA Colorado will strive to follow best practices in ensuring that any messaging directed at a particular demographic group is developed in consultation with representatives from that group. This will be especially important as CAA Colorado translates resources into multiple languages.

Education and outreach materials will comply with state accessibility requirements and the Americans with Disabilities Act, as well as use the principles of universal design, designed so that anyone – no matter their age or ability – can understand the material with minimal or no accommodations.

8.3 Phased Rollout

Communication needs will change over time as recycling, composting and reuse/refill programs are rolled out through 2030. Recognizing this, CAA Colorado proposes a three-phased approach to education and outreach plan implementation, as detailed below.

Phase 1 – Prior to Implementation (2025–2026)

a. Assess the value of in-kind advertising from print publishers to inform how CAA Colorado can leverage this tool.

b. Hire an education and outreach team for Colorado.

c. Conduct research to inform the design and content of education and outreach materials.

d. Within six months of Program approval:

   i. Establish the CAA Colorado education and outreach material resource library and the mechanism for collaborators to access these resources.

   ii. Secure agreements with one or more third-party education and outreach providers or ensure internal resources to coordinate education and outreach activities among provider organizations in open-market areas.

   iii. Release RFRs to enter into service agreements that include education and outreach activities, and reimbursement rates.

e. Launch a statewide public EPR awareness campaign in 2026.

Phase 2 – Transition to EPR System with Residential Focus (2026–2027)

a. Include the cost, scope of work, and KPIs of community education and outreach initiatives into community service agreements.

b. As collection service provider cost reimbursement contracts are negotiated, include the cost, scope of work, and KPIs of education and outreach initiatives that the service provider will implement as part of the minimum service standards.

c. Launch community and regional education and outreach campaigns in collaboration with communities, contractors, and provider organizations as collection service provider cost reimbursement contracts take effect.

d. Drive behavioral change by continuing to conduct education and outreach initiatives to inform the public about the benefits of recycling and the harms of littering.

Phase 3 – Expand to Non-Residential Sector While Maintaining Residential Efforts (2028–2030)

a. Leveraging resources and learnings from residential education and outreach activities, design and implement an education and outreach plan for the non-residential sector.

b. As materials are added to MRL and AML, update education and outreach materials and tactics accordingly.

c. Launch regional education and outreach campaigns in collaboration with contractors and provider organizations to support existing efforts by collection service providers to keep their customers well informed.

d. Drive behavioral change by continuing to conduct education and outreach initiatives that remind the public about the importance and value of recycling and the harms of littering.

e. In 2030, launch a statewide public information campaign about EPR's positive impact.

8.4 Evaluation and Continuous Improvement

Integral to the overall success of the education and outreach plan is periodic evaluation and continuous improvement of the methods and materials used. CAA Colorado plans on an ongoing basis to:

a. Describe the effectiveness of the education and outreach program and provide samples of materials for inclusion in the Annual Report.

b. Collect data to track and measure participation, diversion rates, and contamination rates on a geographic and material-specific basis. CAA Colorado will carry out analyses to assess impacts on environmental justice communities.

c. Collect data before and after education and outreach campaigns to assess improvements in participation and contamination rates among the targeted audiences.

d. Collect quantitative and qualitative data to identify the reach of traditional and social media campaigns.

e. Analyze data internally and with provider organizations to measure the effectiveness of education and outreach materials and campaigns led by CAA Colorado, contractors and other organizations. This may include organizing focus groups to collect feedback. CAA Colorado will collaborate with collection service providers and organizations to adjust education and outreach materials and initiatives accordingly to optimize impact.

Based on the learnings from these efforts, CAA Colorado will adjust its education and outreach plan to enhance its effectiveness in achieving its desired outcomes

9 Operations Plan: Compostable Packaging

Excerpt from the Act

CRS 25-17-705 (4)(u) describe how the organization will work with service providers to: (II) reduce contamination of covered materials delivered to materials recovery facilities and compost facilities by: (A) requiring each materials recovery facility and compost facility participating in the program to report annually to the organization on contamination levels at each facility; and (B) providing funding or other assistance to compost facilities to reduce the costs of managing or increase the effectiveness of efforts to manage contamination and to process and recover compostable packaging materials;

CR 25-17-707 (2) the education and outreach program must, at a minimum: (c) be designed to help the state achieve the minimum collection rate and minimum recycling rate targets established in the final plan under section 25-17-705 (4)(p) and reduce levels and impacts of inbound contamination from covered materials at materials recovery facilities and compost facilities.

This chapter describes how CAA Colorado intends to provide funding, undertake education and outreach activities or other assistance to compost facilities to improve recovery and processing of covered compostable packaging materials, and reduce contamination. For the purposes of this plan, compostable has the same definition used in HB 22-1355 which includes future updates to existing standards.

CAA Colorado will design and implement a comprehensive approach to managing covered compostable packaging that will:

- Increase public awareness of compostable packaging recovery options.
- Increase compostable packaging collection and processing capacity across broader geographic and socioeconomic ranges.
- Decrease contamination related to non-compostable covered materials.
- Improve data collection and performance measurement (producers, covered entities, and processors).
- Track and monitor non-compostable covered material contamination.
- Identify problematic non-compostable covered material contamination and their primary sources by regions, materials, covered entities, and feedstocks, for future interventions.

9.1 General Approach to Compostable Packaging

CAA Colorado will utilize the following general methodology for improved recovery and processing of compostable packaging:

Funding for Compost Facilities:

- Provide direct funding to participating compost facilities to increase the recovery of certified compostable packaging and reduce contamination.

- Starting in year one of the Program, prioritize offering a per-ton or per-cubic yard processing incentive to compost facilities that currently accept and process certified compostable packaging, as well as engage with compost facilities who are willing to commit to developing a plan, timeline, and milestones to accept and process certified compostable packaging.

- In year two of the Program, CAA Colorado will evaluate the option to use the System Development Fund for compost facilities to further advance the aims of increased recovery and reduced contamination.

Leverage proposed education and outreach activities to achieve:

- Widespread public awareness of composting programs and proper end-of-life management methods, including for residential, non-residential, and seasonal resident/tourist audiences through curbside services, local drop-off centers, and alternative collection programs.

- Reduced contamination in recycling and compost streams by communicating the importance of properly preparing recyclable and compostable materials with an emphasis on communities that have curbside service.

Monitor and Track Contamination:

- Require participating compost facilities to provide CAA Colorado with contamination data gathered through visual audits.

- The site-specific data will be supplemented by CAA Colorado's statewide material characterization study that will assess contamination at compost facilities in the State.

- Utilize data to track progress, identify problematic materials, and assess the effectiveness of the funding and education and outreach efforts.

9.2 Investment in Compost Infrastructure

Findings from the Needs Assessment indicated that many compost facilities in Colorado do not currently accept certified compostable packaging. Those that do accept certified compostable packaging report contamination challenges. Producer-funded investments are expected to encourage facilities to accept and process certified compostable materials, increase access to services for covered entities, reduce contamination, and increase system efficiency.

Funding Overview

Under the Act, CAA Colorado is not required to provide ongoing reimbursement to compost facilities. CAA Colorado will instead fund improvements to enhance the management of certified compostable packaging across the state. Key funding assumptions include:

- Funding is based on dues from certified compostable packaging producers, determined by the volume supplied.

- Funding will be scaled based on the volume of source-separated organics within Type 2 feedstock[32] managed by the participating facility, as certified compostable packaging is included in this category.

- Facility throughput assumptions will be based initially on the Needs Assessment and a current list of CDPHE-permitted facilities as of August 2024. Assumptions will be updated annually as more data is collected and more permitted facilities are established over time.

- CAA Colorado will estimate the funding per ton or per cubic yard based on the number of participating compost facilities and establish a maximum cap for individual facilities, by size, to ensure fairness. This will reduce the risk of budget overruns. The funding amounts for the initial program year, including funding per ton or per cubic yard and the maximum cap, are informed by the Needs Assessment analysis and CDPHE-permitted facility data. As part of the annual report, CAA Colorado will assess the impact of the funding provided to compost facilities and evaluate if the funding per ton, per cubic yard, or the maximum cap, should be adjusted. The maximum cap will be based on a dollar threshold. If the maximum funding cap increases from one year to the next, participating facilities will be eligible for the increased funding. If there are unspent compost facility funds CAA Colorado will either roll over the funds to the next year to reduce the dues for producers of certified compostable packaging or, if allowable, will also consider:

  o moving unspent funds into the System Development Fund to increase the available funding for compost funding infrastructure grants,

  o increasing the funding per ton or per cubic yard or the maximum cap for individual facilities in the following program years.

Funding Approach

CAA Colorado's approach for investing in new or upgraded composting infrastructure aligns with the approach for investments in MRFs, transfer facilities, and other recycling-related improvements. This initially relies on the establishment of contractual agreements with compost facilities. In Program year two, CAA Colorado will evaluate the impacts of the incentives and the potential to provide additional funding through the System Improvement Fund for cases requiring up-front capital.

Contractual Approach: The primary mechanism for supplying funding to compost facilities will be through the establishment of multi-year agreements with eligible facilities. The agreements will include incentive payments based on processed source-separated organics (SSO) (dollars per ton or dollars per cubic yard). Under this model, CAA Colorado will not provide up-front capital funding

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[32] Type 2 feedstock is defined in CDPHE solid waste regulations and includes food residuals, source separated organics, manure, and animal waste.

for system improvements in the first year, or years, of the program, instead depending on service providers to secure the necessary capital for upgrades. CAA Colorado will provide financial payments for these investments through long-term service agreements, enabling providers to offset operational and capital costs. Payments will depend on supplied tons of covered materials, dues collected from producers of certified compostable packaging, the total number of compost facilities that enter into agreements with CAA Colorado, the tons of processed SSO, and the terms of those agreements. Payments will be calculated based on a per ton or per cubic yard of source-separated organics processed basis, with a maximum annual amount. CAA Colorado will use the in-bound SSO as a proxy for the quantities of compostable packaging received given the potential cost associated with accurately measuring compostable packaging received at compost facilities (i.e., it makes up a small percentage of overall source separated materials received)[33]. The amount of compost manufactured with source separated organics per program year by each participating facility will be reported to CAA to help ensure that inbound covered materials are processed into finished product. Compost processor agreements may also request additional data from participating compost facilities to verify that the funding was used to achieve programmatic aims.

The funding will be available to compost facilities to reduce costs or increase the effectiveness of efforts to manage contamination, and to process and recover certified compostable packaging materials. Reporting requirements will align with the annual material characterization reporting process for efficiency. CAA Colorado will allow for flexibility in the investment approach taken by each facility to meet the legislative outcomes which could include collection interventions.

To improve equity among compost facilities, maximize impacts, and distribute funding across the state, facilities with lower annual throughputs may initially receive a higher payment rate per ton or per cubic yard compared to those with larger throughputs. Additionally, CAA Colorado will cap the maximum funding amount any single facility can receive in a calendar year. Maximum funding caps may vary by facility processing capacity. CAA Colorado funding must be used to advance the aims of the Program and allowable uses will be detailed in the contractual agreements. To enter into service agreements, compost facilities must accept and process certified compostable packaging from covered entities.

Compost facilities that do not accept covered certified compostable packaging from covered entities may be eligible for other incentives and funding. To be eligible, agreements would include a commitment to move toward acceptance of certified compostable packaging in a specified timeframe. Agreements would include agreed upon milestones, describe what materials would be accepted, when they would begin to be accepted, the mechanism by which materials would be composted, and the intended use of the funding (i.e., goods or services needed to conduct field and/or lab testing to help optimize conditions for compostable packaging at the compost facility).

System Development Fund: After the first Program year, CAA Colorado will evaluate the impact of the contractual incentives and consider whether investment through the System Development

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[33] Colorado compost facilities already report to CDPHE on processed source separated organics, so this approach was considered as an easier means of reducing administrative burden.

Fund is needed. As outlined in the *System Expansion* Chapter, CAA Colorado's preferred method to enhance effectiveness and reduce contamination is through financial payments included in service agreements. However, CAA Colorado recognizes that additional capital may be needed to reduce the costs of managing contamination and recovering certified compostable packaging materials. If needed, dues collected from producers of compostable packaging could be directed to the System Development Fund and made available to eligible compost facilities needing up-front capital but unable to secure it from private lenders, investors, state grants, or other sources. Compost facilities requesting these funds would be evaluated based on specific criteria and awarded lump-sum grants. Grants would be provided on a reimbursement basis.

Alignment with Other Funding Sources

CAA Colorado is aware of existing funding sources that support upgrades to composting infrastructure in Colorado. Where possible, CAA Colorado will coordinate with these programs to identify opportunities for investments. These programs are managed by various entities, including federal and state agencies, non-profit organizations focused on recycling, and material- or industry-specific funding sources. Examples of alignment may include finding matches, incentives payments that align with Colorado Circular Communities (C3) investment timelines, or others.

9.3 Reporting and Monitoring Requirements

Through service agreements, CAA Colorado will establish reporting and performance requirements to maintain access to funding, which could include:

- Maintaining federal and state regulatory and local permit compliance.

- Meeting US Composting Council (USCC) Seal of Testing Assurance[34] or equivalent requirements for compost product sampling and testing.

- Periodic reporting on contamination rates and contamination reduction including the self-managed bi-annual audits described in the *Contamination Reduction* Chapter, and participation in CAA Colorado's material characterization study, if applicable.

- Annual reporting on the use of the funding provided and the estimated impact of the investments (e.g., contamination reduced, additional tons or cubic yards processed, new materials accepted).

- Specifying the agreed-upon timeframe and conditions for accepting certified compostable packaging materials at the facility (if applicable), and how the materials will be processed.

- Prior to receiving funding, interested compost facilities must provide baseline material characterization data from the previous year, such as quantity of feedstock processed, the quantity of compost produced, contamination rates, and the estimated quantity of compostable packaging accepted.

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[34] USCC Seal of Testing Assurance Certified Compost program https://www.compostingcouncil.org/page/STARequirements

9.4 Education and Outreach

Funding for education and outreach activities specific to compostable packaging contamination will be included in the general education and outreach program. Composting education and outreach goals are to:

- Increase public awareness of compostable packaging recovery options.

- Increase public awareness on the benefits of composting including uses of finished compost.

- Reduce contamination in recycling and compost streams by communicating the importance of properly preparing recyclable and compostable materials.

The composting education and outreach activities use content and activities described in the *Education and Outreach* Chapter, including messaging, provision of content and tools, and in-kind advertising with publishers. Similar metrics will be used to measure effectiveness.

To achieve these compostable packaging education and outreach goals, CAA Colorado proposes to:

- Leverage data to identify problematic packaging contaminants and their primary sources and work with compost facility operators to implement solutions.

- Provide consistent messaging to consumers regarding where certified compostable can be composted.

- Provide messaging on compostable packaging and food service ware including what materials can be composted and where they are accepted with tailored messaging to communities that have curbside service.

- Analyze contamination data on a periodic basis to assess targeted campaigns.

- Leverage collaborations with local governments and community-based organizations to provide outreach to targeted covered entities to address significant and/or recurring localized contamination issues.

9.5 Continuous Improvement

Beginning in 2027, and annually thereafter, CAA Colorado will submit a report to CDPHE that will include an evaluation of CAA Colorado's efforts to increase recovery of compostable packaging materials and reduce contamination. The annual report will assess changes in contamination based on the results of the facility audits and the statewide characterization study. It will specifically identify the non-compostable covered materials that contribute to contamination at compost facilities and will include an assessment of the impact of the funding provided to compost facilities through incentives, and the System Development Fund (if applicable). The report will also document the education and outreach efforts conducted under the Program and identify areas for continued improvement or innovation.

10 Operations Plan: Contamination Reduction

Excerpt from the Act

CRS 25-17-705 (4)(u) describe how the organization will work with service providers to: (II) reduce contamination of covered materials delivered to materials recovery facilities and compost facilities by: (A) requiring each materials recovery facility and compost facility participating in the program to report annually to the organization on contamination levels at each facility; and (B) providing funding or other assistance to compost facilities to reduce the costs of managing or increase the effectiveness of efforts to manage contamination and to process and recover compostable packaging materials.

CR 25-17-707 (2) the education and outreach program must, at a minimum: (c) be designed to help the state achieve the minimum collection rate and minimum recycling rate targets established in the final plan under section 25-17-705 (4)(p) and reduce levels and impacts of inbound contamination from covered materials at materials recovery facilities and compost facilities

This chapter details a program to reduce contamination that requires involvement from every actor in the supply chain. The following table defines from the actors, risks, mitigations and measurement for contamination reduction.

Table 24: Contamination Sources, Risks, Mitigation, Measurements, and Tracking

Actor	Contamination Risks	Risk Mitigation	Measurement and Tracking
Producer	• Some materials impact the quality of other materials in the collection system	• Leverage eco-modulation and recyclability guidance to incentivize producers to design packaging materials that are easy to process, reduce contamination, and reduce the overall cost of recycling or composting	• Annual reporting of supplied products by material category

| Covered Entity | • Confusion on what is and is not recyclable

• Not properly preparing materials for recycling (e.g. unrinsed containers)

• Expansion of services to covered entities that have not previously participated in recycling | • Develop and deploy educational materials that provide clear direction on what materials are accepted and not accepted for recycling, considering the needs of diverse populations

• Develop and deploy education and outreach materials that provide clear direction on how to prepare materials for recycling, considering the needs of diverse populations

• Develop and deploy education and outreach materials focused on the importance of recycling correctly and the resulting downstream issues that occur with contamination | • Inbound material characterization audits at receiving facilities, including transfer facilities and MRFs, and compost facilities |

| Collection Service Provider | • Expansion of service to newly covered entities, including multifamily residents, that may not have been recycled in the past

• Inability to identify individual sources of contamination that repeatedly contaminate their recycling bin

• Illegal dumping at drop-off centers | • Develop minimum standards that encourage behavior change via service or financial consequences for covered entities that are repeated sources of contamination

• Include performance-based incentives in service agreements to encourage service providers to adopt new technologies or strategies to reduce contamination at the point of collection

• Develop best practices for collection service providers that prevent isolated sources from contaminating entire truckloads

• Via collection service provider agreements, CAA Colorado will set standard expectations for the material characterization methodology

• Develop minimum standards in drop-off facility design that discourages illegal dumping | • Inbound material characterization audits at receiving facilities, including transfer facilities and MRFs |

Material Recovery Facility (MRF)	• Poorly maintained or inadequate sorting equipment reduces the quality of baled materials • Inability to isolate significantly contaminated loads on the tipping floor prior to those materials entering the MRF's sorting system	• Via individual collection service provider agreements, set expectations on a feasible material characterization methodology • Invest in capital improvements that improve sorting efficiency and performance	• Incoming and outgoing composition studies at MRFs • Measurements of outgoing tons to REM and residue rates
Compost Facility	• Limited or no quality control of inbound source separated organics • Inability to isolate significantly contaminated loads prior to those entering the composting process	• Provide funding to participating compost facilities to reduce source separated contamination and increase recovery of compostable packaging • Visual audits are performed by compost facilities	• Compost facility bi-annual contamination reporting (completed and reported by participating compost facilities) • Statewide organics waste characterization studies (completed by CAA at least biennially)

Despite CAA Colorado's efforts to reduce contamination, it will inevitably occur at various stages of the supply chain, especially as more covered entities are added to the system that may have limited experience with recycling programs. As the Act requires each participating material recovery facility and compost facility participating to report annually to CAA Colorado on contamination levels at each facility[35], CAA Colorado will develop and implement a material characterization methodology to assess and measure contamination. The data collected in the material characterization audits will also be utilized to support ongoing tracking of collection and recycling rates required for annual reporting.

10.1 Material Characterization Methodology

CAA Colorado will administer, operate, and fund material characterizations with data shared at regular intervals with CDPHE, local governments, service providers, and the public. CAA Colorado will use this data to measure the effectiveness of CAA Colorado's education and outreach efforts as well as inform future education and outreach tailored to specific audiences. The data will also

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[35] 25-17-705 (4)(u)(II)

be used to calculate the annual collection rate metrics. CAA Colorado will provide guidance and clarify expectations to ensure participants have the information they need to contribute to CAA Colorado's efforts to monitor contamination.

The material characterization methodology detailed below is modeled after similar systems that have shown to be successful in other jurisdictions that operate paper and packaging EPR programs. It is also informed by the Needs Assessment and best practices. The centralized approach leads to overall cost efficiency, consistency in how contamination is measured, and a growing pool of data that can help highlight important trends and opportunities for improvement in material contamination.

Sampling Methodology and Data Aggregation

Contamination tracking and reporting is essential for CAA Colorado to maintain consistent oversight of contamination levels, identify target materials, track seasonal variations, and monitor trends. The auditing and contamination reporting process will be designed to minimize resource use and disruption to daily operations while collecting meaningful and actionable data.

CAA Colorado understands the process may require adjustments over time to reflect changes in material flow, variability associated with the results of the audit sampling, and increased knowledge surrounding the Program. Reviews of the process will include a regular analysis of the sample categories to ensure the list is updated with the latest materials and any contamination categories necessary to help improve performance.

Material Recovery Facilities and Transfer Facilities

The contractual agreement with each participating MRF or transfer facility will include terms and conditions that require operators to support CAA Colorado's efforts to measure contamination and assess collection and recycle rates through material characterization studies. Facility operators may be required to generate samples of collected materials by hauling route, store samples in a segregated manner, preserve the integrity of each sample, store samples for pick-up or ship samples to CAA Colorado's designated audit location, and/or provide space to conduct an on-site waste characterization study. Additionally, CAA Colorado will develop a reporting protocol through which the facility will gather and report to CAA Colorado all inbound tonnage data, tied to participating collection service providers, so that CAA Colorado can aggregate data by wasteshed and region to understand broader contamination trends. Any costs incurred by the facility would be reimbursed according to the terms of the service agreement.

CAA Colorado will organize and lead each material characterization study. The number of samples required, and the frequency of each study will be tailored based on the volume of material processed at the facility, operational limitations, seasonality, and implementation costs. Periodic and less formal visual spot checks to monitor emergent or significant contamination issues may also be implemented, coordinated directly by CAA Colorado staff or in collaboration with the facility operator and their staff.

CAA Colorado's goal is to gather data that informs and improves the performance of the Program. The material characterization studies will consider the timing of the service strategy as well as the commingling of material in collection and post-collection environments. The focus of studies beginning in 2026 will be on material generated by residential entities and then phasing in samples from non-residential covered entities as they begin to deploy in 2028. See the *System Expansion* Chapter for more insights into this timing. Both residential and non-residential samples have the potential to contain non-covered materials and/or materials from non-covered entities. Additionally, there may be periods of time where MRFs are upgrading equipment and processes to accept new covered materials, and these can temporarily be considered a contaminant. These factors can complicate the material characterization studies. CAA Colorado will be recording composition by covered material by reporting categories. Other contaminants will be observed but may not be recorded to the detail of the Program's covered materials.

The results of the material characterization studies are critical to CAA Colorado initiatives such as education and outreach activities, and service provider reimbursement. CAA Colorado may publish material characterization reports that aggregate data while respecting confidentiality in service provider agreements.

Compost Facilities

Each participating compost facility will include in their service agreement with CAA Colorado terms and conditions that require operators to support CAA Colorado's efforts to measure contamination via compost facility led visual audits and CAA Colorado led waste characterization studies. CAA Colorado intends to follow the same general protocol used for measuring covered material composition to conduct compostable packaging waste characterization studies.

To collect timely waste composition data that CAA Colorado can use to respond to significant or emergent contamination issues, participating compost facilities will be required to conduct self-managed bi-annual audits (approximately six months apart). The specific contamination reporting requirements will be detailed in the service agreement between the compost facility and CAA Colorado, but the scope will ultimately depend on the amount of compost produced from source separated organics, operational limitations, staff capacity, seasonality, and implementation costs.

To collect granular data based on specific material category, CAA Colorado will organize and lead in-depth waste characterization studies to better understand contamination issues that are unique to both residential and non-residential waste streams. CAA Colorado will coordinate with compost facilities to collect an adequate number of samples for the purposes of conducting a robust waste characterization study. Samples will be pulled from inbound materials.

In the event a sample contains non-compostable covered materials, these contaminants will be categorized in a way that reflects the covered materials reporting categories. Acceptable materials will also be categorized in a way that reflects the covered materials' reporting categories for compostable packaging. The waste characterization studies are focused on identifying non-compostable covered materials that are in in-bound materials. The duration and frequency of these

audits will be based on CAA Colorado's available resources. Beginning in 2026, CAA Colorado will conduct no fewer than one in-depth waste characterization study every two years that will be large enough in scope to assess statewide contamination levels. CAA Colorado will seek efficiencies in these studies to ensure that most funds allocated to compostable packaging goes into funding infrastructure improvements.

11 Operations Plan: Reuse and Refill

> **Excerpt from the Act**
> 25-17-705 (4)(u)(IV) Propose an approach to measure and report on the use of reusable and refillable covered materials and establish goals and strategies for increasing the use of reusable and refillable covered materials.
> 25-17-705 (4)(v) Describe how the organization will work with and incentivize producers to reduce the packaging of products using covered materials through product design changes, the development or expansion of systems for reusable packaging, and product innovation.

11.1 Reuse and Refill Goals

The Program has six primary goals related to reuse and refill:

1. Continuous increase in the use of reusable/refillable packaging.

2. Measure and track increased use of reuse/refill through producer reporting.

3. Build on cross-state efforts to encourage adoption of reuse/refill systems.

4. Apply eco-modulation to incentivize reporting on, and increase supply of, reusable and refillable packaging.

5. Enable opportunities for system investments that could facilitate producers to switch from a covered material to reusable/refillable formats.

6. Implement activities that highlight the benefits of reuse/refill systems and address opportunities for producers to overcome barriers to switching to reusable/refillable packaging.

Background

Certain reusable and refillable packaging are exempt from dues, including:

- Return from home: Packaging that is returned by the consumer through a residential pick-up service (e.g., by a logistics company). A business or service provider is responsible for the cleaning and redistribution of the packaging.

- Return on the go: Packaging that is returned by users to an in-store or centralized drop-off point (e.g., in a Reverse Vending Machine or a mailbox). A business or service provider is responsible for the cleaning and redistribution of the packaging.

- Refill on the go: Packaging that is refilled by consumers at an external dispensing point, such as a store. The user is responsible for cleaning and maintaining the packaging.

There is a fourth type of packaging often referred to as "refill at home packaging" that is not exempt and is obligated as a covered material to be managed by and reported to CAA Colorado. Refill at

home packaging is refilled by the consumer by purchasing refill contents in packaging that contains less material per unit of final product than the original container (e.g., purchasing concentrates in smaller containers, purchasing refill contents in containers that lack dispenser nozzles). This packaging does not meet the statutory definition of reusable or refillable packaging as it requires the use of additional packaging to enable the packaging refill.

11.2 Challenges to Measurement and Reporting on Reuse and Refill

Producers are encouraged to reduce the amount of single use packaging they supply by switching to reusable/refillable formats. As packaging decisions are often made by producers at a national level, efforts to encourage reuse/refill in Colorado will align with and build on efforts in other states where EPR is in place and reuse/refill plans are required (e.g., California, Oregon). CAA Colorado's plan has been carefully considered to ensure it incentivizes producers to implement reuse/refill across states, while at the same time recognizing that reuse/refill methods may be different.

Measuring Reuse and Refill

The first step for measuring progress toward increasing reuse/refill is to establish metrics and set a baseline for ongoing measurement. To calculate its baseline, CAA Colorado will collect producer data on their existing reuse/refill systems and the amount of single use packaging those systems have displaced. Ongoing changes will be measured against this baseline.

To establish metrics, CAA Colorado will need to overcome several challenges, including:

- A lack of a clear distinction between what Colorado defines as a durable product (e.g., a travel mug, a food storage container, a tote bag, a barbeque propane tank) and reusable/refillable packaging.

- Producers of reusable or refillable packaging systems may choose not to report because they are statutorily exempt if:

  o They fall under the gross revenue or weight thresholds of supply to market.

  o They supply packaging that meets the legal definition of reusable/refillable materials in Colorado.

- Producers of reusable/refillable packaging may have to provide data to the PRO to prove the type of packaging they supply meets the legal definition of reusable/refillable and is exempt (e.g., number of cycles achieved per package). However, statute does not require producers of reusable/refillable packaging to report on its supply to market nor its end-of-life management.

- Producers may not have systems in place to accurately verify and measure the number of trips or rotations per year within a system for reuse.

- While producers plan packaging at a national level, they may face conflicting requirements for reuse/refill on a state-by-state level, including reporting requirements. This can create an administrative confusion that could be a disincentive to reporting.

11.3 Approach to Measurement and Reporting on Reuse and Refill

To enable measurement and reporting on reuse/refill, including overcoming the above challenges, CAA Colorado will:

- Collect data from obligated producers of refill-at-home packaging.

- Encourage voluntary reporting through a survey process on non-obligated reuse/refill activities from producers.

- Work closely with producers and other interested parties to align data collection and measurement practices with those being developed for reuse/refill in other states (e.g., Oregon, California, Maine, Minnesota, Maryland), as well as with efforts being led by non-profit organizations nationally and in Colorado.

- Develop guidance reporting processes, and systems, to help producers with accurate and convenient reporting.

To encourage reuse/refill reporting, CAA Colorado will provide incentives for producers to voluntarily report data, including:

- Undertaking education and outreach campaigns to increase public awareness on reuse and refill systems of producers that report data.

- Providing economic incentives for obligated producers to switch to, and report verifiable data on, reusable/refillable packaging through eco-modulation.

The reuse/refill reporting process will be separate from covered materials reporting and may use the producer portal to capture this data. CAA will assess the amount and quality of voluntarily reported data after the 2026 program year to determine if additional efforts may be needed to increase data reporting.

To accurately measure reuse/refill supply, data will be needed at an individual stock keeping unit (SKU) level and connected to the single use packaging the reusable/refillable packaging is displacing.

The key variables required for measuring source reduction through reuse/refill are:

1. The weight per SKU of single-use packaging.

2. The number of SKUs sold in a year for both single and the comparable reusable packages.

3. The weight per SKU of the reuseable packaging to be used in place of the single use packaging.

4. The number of rotations the reuseable packaging has in a year.

The calculation would require that the weight and number of rotations of reusable containers be tracked and verified. This is generally possible for the returning-from-home or on-the-go models and much more difficult for refill models. CAA Colorado recognizes the challenges in data tracking, verification, and reporting for reuse and refill, so voluntary reporting will be incentivized.

11.4 Establishing Reuse and Refill Targets

The lack of detailed information makes developing a target for reusable and refillable packaging challenging. Only qualitative information was available in the Needs Assessment[36], however the scenario development did include a source reduction factor in covered materials, that considered both potential lightweighting of packaging and increase in reuse/refill systems[37].

This factor was only a small focus of the Needs Assessment modelling and not based on exhaustive research. The project team, with CAA Colorado, the advisory board, and CDPHE, agreed to include this source reduction factor in its estimated Program impacts, as there are general trends to lightweight and support reuse/refill systems. There is no-reliable data in Colorado on reuse and refill weights or single use displacement.

As result of this data gap, it is difficult to establish a specific target for reusable/refillable packaging. Instead, CAA Colorado will set a baseline and initially establish the following improvement reuse/refill target:

"Increase the use of reusable and refillable packaging within the state year over year."

In 2026, CAA Colorado will begin to collect data to establish a baseline of reusable and refillable packaging supplied annually. In subsequent years, CAA Colorado will track changes over time and report data in the annual report. Following the establishment of a baseline and an accurate data reporting and verification protocol, CAA Colorado will establish a specific target as opposed to a continuous improvement metric. This metric and target will be included in the five-year Program update.

11.5 Increasing Reuse and Refill

The following section outlines CAA Colorado's approach to increasing the use of reusable and refillable packaging. CAA Colorado will summarize ongoing progress in the Annual Report and will

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[36] Accurate data on the baseline of reuse and refill in Colorado does not exist at the time of this program plan's submission.

[37] This factor was material agnostic and considered waste reduction across all materials equally. The modelled scenarios included a 5 percent reduction per capita by 2030 and a 10 percent reduction per capita by 2035. The model also considered general population growth. As the waste reduction factor was done on a per capita basis, the population growth will offset the total waste reduction estimated. In 2022, total generation of covered materials in Colorado was estimated to be 1,250,000 tons, by 2030 it was estimated to be 1,290,000 tons, and by 2035 it was estimated to be 1,320,000 tons. This shows that even with modest per capita or per SKU source reduction (e.g., shift from disposable to reusable/refillable) an overall tonnage reduction across the state will be a challenge.

continue to consult with interested parties and the advisory board to refine this approach over time.

Economic Incentives

CAA Colorado will provide a financial incentive to producers using reusable/refillable packaging through an eco-modulation incentive, available to producers of covered materials that have established new reusable or refillable systems (see *Program Budget and Producer Dues* Chapter). This would be initially established through an eco-modulation incentive verification approach that would require producers to provide information.

As the aim of the incentive is to drive system change and improvement, incentives will not be available to producers who have pre-existing reusable and refillable packaging.

Special Assessments

Colorado would also support a special assessment at the request of producers that want to invest in reuse/refill systems. By making these investments, participating producers could lower their program dues, as they would no longer have to pay dues on packaging that shifts from being part of the program to meeting the regulatory definition for reuse. The special assessment would be paid by the producers of a covered material to fund system improvements to support the transition to reusable and refillable packaging formats. These assessments could include investments in infrastructure such as wash facilities, consolidation hubs, reusable items, sorting, and tracking technology. Special assessment funding would be determined by CAA Colorado on a case-by-case basis in response to producer requests.

Education and Outreach

CAA Colorado will focus its public-facing education and outreach activities on highlighting, the benefits of reuse and refill systems including:

- Consulting and collaborating with service providers, local governments, tribal nations, community and other organizations to deliver messaging customizable templates, image libraries content, and other guidance that promotes local reuse and refill systems.

- Promoting the benefits of reuse and refill to target audiences using a broad range of tools and channels such as websites, apps, social media, print and broadcast media, pamphlets, stickers, calendars and signage, and storytelling.

- Collaborating with local, state, and national organizations focused on reuse and refill to further elevate their messaging and engagement efforts.

Additional details on the education and outreach approach are included in the *Operations Plan: Education and Outreach* Chapter.

Community of Practice

Providing guidance to producers on opportunities and best practices to increase reuse and refill will be conducted through the establishment of a Community of Practice for Reusable and Refillable Packaging. This Community of Practice consists of parties who want to make their packaging more sustainable by studying and implementing reusable/refillable options. CAA Colorado will build on the expertise of provider organizations to develop tools and guidance materials to producers to assist them investigating and establishing reuse and refill packaging systems. Activities might include:

- Supporting the development or expansion of systems for reusable packaging and product innovation.

- Better understanding which products can be more easily transitioned to reusable/refillable designs.

- Better understanding the barriers to transition to reusable packaging, such as current legislation and consumer preferences.

- Exploring ways to overcome logistical and administrative barriers.

- Developing and enabling safe and efficient reusable and refillable packaging solutions.

- Analyzing opportunities and barriers related to consumer behavior.

- Providing insight into the factors that influence the environmental and financial break-even point of a reusable packaging compared to single use.

This Community of Practice would support and provide learning sessions, publications, working group meetings and tools.

12 Operations Plan: Postconsumer Recycled Content

> **Excerpt from the Act**
>
> 25-17-705 (4)(p) set targets for the minimum collection rates, minimum recycling rates, and minimum postconsumer-recycled-content rates for certain types of covered materials, including paper products, glass, metal, and plastic, that the state will strive to meet by January 1, 2030, and January 1, 2035.
>
> 25-17-705(4)(q) describe how the organization plans to continue to increase the state's minimum collection rates, minimum recycling rates, and minimum postconsumer-recycled-content rates after January 1, 2030, and January 1, 2035
>
> 25-17-705 (4)(r) describe how the organization will verify minimum postconsumer-recycled-content rates and how postconsumer-recycled-content rates will be calculated using weight and other metrics, and describe any waivers from minimum postconsumer-recycled-content rates granted to a type or subcategory of covered materials and the criteria for evaluating such waivers, including food safety requirements, technological feasibility, or inadequate supply, and how often the waivers will be reviewed;
>
> 25-17-705 (4)(s) describe how the organization will provide producers with the opportunity to purchase postconsumer-recycled materials from processors at market prices if the producer is interested in obtaining recycled feedstock to achieve minimum postconsumer-recycled-content rates.

The Program will achieve three primary goals[38] related to postconsumer recycled material (PCR):

1. Drive market demand over time by setting minimum PCR content rate targets by material class (e.g., paper, rigid plastic, flexible plastic, metal, glass) for producers. PCR content rate means the amount of postconsumer recycled materials used in the production of covered materials in a calendar year divided by the amount of covered materials used for products sold or distributed by producers within or into their United States market territory in the same calendar year.

2. Calculate and verify PCR content rates while including a waiver process for those producers that may face technical, market, and regulatory barriers using PCR material in packaging.

3. Provide producers with the opportunity to purchase PCR materials at market prices.

The Program seeks to achieve the following outcomes:

- Increase in market demand for PCR materials as collection volumes increase.

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[38] A description of how CAA Colorado will prioritize the use of end markets that return postconsumer recycled materials to their original product type is provided in *Chapter 13 Operations Plan: Responsible End Markets*. Information describing how CAA will work with service providers to achieve this aim is included in *Chapter 6. Operations Plan: Service Provider Reimbursement*.

- Increase in PCR content rates.

- Create opportunity for higher use of PCR material in packaging types (glass, metals, paper packaging).

- Provide producers greater access to PCR content for incorporation in covered materials.

- Reduce administrative burden for verification of PCR content targets through process alignment with other jurisdictions.

The following details how CAA Colorado will achieve the above goals. Additionally, the *Eco-Modulation Approach* Chapter explains how specific eco-modulation factors will be applied to create incentives for producers to exceed the minimum PCR content rates.

12.1 Set PCR Content Targets

Several factors informed CAA Colorado's approach to setting PCR content targets:

- PCR content targets are meant to bolster packaging material markets and improve demand for PCR.

- According to interested parties' feedback received during CAA Colorado's consultation, as well as available industry data for the U.S. (e.g. U.S. Plastic Pact, American Forest and Paper Association (AFP&A), StatMill Report), markets for plastics, glass, and some paper products used in food-contact packaging could be improved.

- The packaging source influences the scope of PCR content targets (as defined by a specific state). For example, in Colorado, covered materials are predominantly manufactured in other states, and then sold in Colorado.

- Effort should be made to set PCR content targets that are consistent with other jurisdictions (e.g. Washington, New Jersey, California).

- There is limited data that can inform the current PCR content for some materials, especially plastics. For instance, the US Plastic Pact 2022 annual report suggests the average rate is below 10 percent for plastic producers who are signatories of the U.S. Plastic Pact.

Based on the above, CAA Colorado will:

- Set different minimum PCR content targets by general material categories (e.g. metal, glass, paper, rigid plastic, flexible plastic) for producers to achieve by January 1, 2030.

- Measure annual progress towards the PCR content rate targets based on the average weight of the PCR materials used by producers within the United States market territory, reported by PCR reporting category.

- Review the initial Program targets three years after implementation and assess data to determine if one or more targets should be adjusted.

- Grant individual producers a waiver from meeting the minimum PCR content targets where using PCR is not technically or economically feasible or when the industry can demonstrate it is broadly able to reach the PCR content target.

- Develop a standardized reporting process to ease the administrative burden on producers.

12.2 PCR Content Targets

The PCR content targets are presented in the table below, including CAA Colorado's assessment of current PCR content levels. These targets operate differently from those found in other states as these PCR targets will have to be reached on the overall tonnage supplied by all producers of covered materials. Individual producers will be required to report PCR content based on United States market territory average for each PCR reporting category. Progress toward the material targets will be measured based on aggregated data from all producers. As a result, producers do not have to meet these targets individually, and there are no individual financial consequences for not meeting these targets.

CAA Colorado will consider the addition of more material specific PCR targets (e.g., resin specific) as part of the next Needs Assessment. Given these are new reporting requirements, CAA Colorado does not want to create additional administrative burden within the first years of operation.

Table 25: PCR Content Level Targets Over Time

PCR Material Category	Estimated 2024 PCR content Level[39]	Proposed 2030 Target	Considerations	Proposed 2035 Target
Rigid plastic packaging	9–11%	**20%**	- Potential lack of supply, especially for certain resins (e.g. PE, PP) - Challenging for small-scale producers to access sufficient quantities of certain resins - Technical challenges related to color, food contact, etc.	**25%**, To be further adjusted after 3 years of data has been collected

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[39] CAA Colorado estimates based on published reports, discussions with trade organizations, and discussions with producers.

Flexible plastic packaging	1% or less	**5%**	• Limited supply availability due to lack of recycling infrastructure • Technical challenges associated with the product's physical characteristics	**10%**, To be further adjusted after 3 years of data has been collected
Paper product and packaging	30 − 40%[40]	**40%**	• Mature market for containerboard but technical challenges associated with white paper and food packaging products	**45%**, To be further adjusted after 3 years of data has been collected
Metal packaging	30 – 40%[41]	**40%**	• There may be technical challenges associated with basic oxygen furnaces, vessels used to convert iron, that limit PCR incorporation	**45%**, To be further adjusted after 3 years of data has been collected
Glass packaging	15 − 25%[42]	**30%**	• Limited feedstock for glass beneficiation plants could impact the supply availability for container manufacturers	**35%**, To be further adjusted after 3 years of data has been collected

PCR content will be calculated as follows:

(Total weight of PCR used for all packaging/product sold or distributed within or into the US) ÷ (Total weight of packaging/products sold or distributed within or into the US in a year) = PCR Content

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[40] AF&PA reports average recycled content of 45% in 2023, report does not consider overseas product and yield loss.

[41] Based on data from Aluminum Association and RRS Steel Can Recycled Content White Paper, CAA Colorado's assessment of current recycled content rates are 40%. However, packaging, represent a small proportion of the overall recycled content, limiting CAA Colorado's capacity to drive the market, and producers' capacity to meet the target for packaging. Note that pre– and post–consumer content is not well tracked.

[42] CAA Colorado market research indicates that the PCR content for North American glass containers may be between 22% to 28%.

For clarity, CAA Colorado producers should include post–consumer materials from both the residential and the commercial sector, if materials have served their intended use, whether by a residential consumer or a commercial consumer.

CAA Colorado will request the glass, metal, fiber, and plastic industries to provide an assessment of the average PCR within the materials they produce. If the assessment demonstrates that the average PCR in North American production is above the targets, producers using the materials in those categories will be granted a waiver to report on PCR for those materials[43]. For these materials, CAA Colorado will consider a verified industry average at or above the minimum target as sufficient for achieving the target.

Waivers

Recognizing some packaging applications are limited in their capacity to incorporate PCR, CAA Colorado will consider granting waivers for reporting on PCR inclusion in certain covered material categories.

CAA Colorado will undertake a material availability gap study, no less than every three years, to identify materials for which meeting PCR targets is not technically feasible without impacting the quality or the safety of the product the packaging contains, and those materials for which market conditions, including supply and demand, limit the availability in sufficient quantity to meet the PCR targets. Additionally, producers using packaging for which meeting PCR targets will render the producer non–compliant with federal regulations may be granted a waiver.

To secure a waiver, producers will have to provide:

- The rationale for the waiver.
- The tonnage that waivers will represent on the overall tonnage supplied in Colorado.

The first material availability gap study will be conducted in 2025. Study results and decision on the waivers will be subsequently published and available in CAA Colorado producer guidance materials. Additional guidance for PCR waivers will be made available before 2026 dues reporting.

12.3 PCR Target Verification – Overall Approach

CAA Colorado highlights the following elements for PCR verification, which have also been informed by feedback from CAA Colorado's consultations process, the advisory board, and CDPHE:

1. PCR means only the covered materials that have been separated or diverted from the waste stream for the purposes of collection and recycling as a secondary material feedstock for covered materials. Recycling does not include use as a fuel.

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[43] This will be based on verified industry data. For instance, if AF&PA provides sufficient evidence that paper mills in the US are producing materials that are over 20% PCR, producers will not have to individually report on paper recycled content as it is assumed it will have achieved the minimum target.

2. CAA Colorado does not intend to create a new standard to verify the use of PCR content as various standards and certifications already exist.

3. Not all suppliers have their PCR verified by a third-party certification scheme because of the administrative burden, especially for materials where PCR is common, such as metal and glass.

4. Several chain of custody models exist that can meet the need for rigorous transparency and proper tracking.

The Program's framework for verification consists of:

- Setting a baseline framework of requirements that align with existing third-party certification schemes and ISO 22 095 (Chain of Custody – General Terminology and Models).

- Authorizing, in consultation with CDPHE and the Advisory Board during the program plan development process, the use of non-certified PCR[44] for producers that rely on suppliers' self-attestation for the 2030 target. Where CAA Colorado authorizes this methodology, it will also be subject to auditing the chain of custody. After that date, all PCR would have to be certified by a standard complying with the above requirements.

- Providing flexibility in verifying PCR using different chains of custody models.

Proposed Verification Framework

The table below details the proposed framework for verifying PCR.

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[44] Except for PCR produced through mass balance credit method.

Table 26: PCR Verification Framework

Framework component	Requirement
Recognized Chain of custody models	CAA Colorado recognizes the use of the following chain of custody models: • Segregated (as defined in section 5.3.2. of ISO 22 095) • Controlled blending (as defined in section 5.4.1. of ISO 22 095) • Mass balance rolling average (as defined in section 5.4.2.2.1. of ISO 22 095) • Mass balance credit method (as defined in section 5.4.2.2.2. of ISO 22 095), with the boundaries established within CAA Colorado framework Excludes 'book and claim' chain of custody models (as defined in section 5.5. of ISO 22 095) where the sustainability attributes of packaging are tracked and transferred separately from the physical packaging itself.
Geography	CAA Colorado will not restrict the geographical source of the PCR, if the physical traceability in products sold in the U.S. can be verified.
Feedstock	Only PCR content as defined by ISO 14 021 can be claimed for calculation.
Recognized Allocation Procedures for Mass Balance Credit Method	Recognized allocation procedures include: • Proportional

CAA Colorado will only allow for the use of third-party certifications schemes that verifiably exclude fuel from PCR claims. CAA Colorado will review certification schemes to assess alignment with CAA Colorado's framework, criteria in the Act, and usefulness for producers within CAA Colorado's verification process. Using PCR content certified by third-party certification schemes will be optional for producers, except for any PCR content claimed via mass balance credit method.

Allocation Procedures for Mass Balance Credit Methods that Require Additional Process: Polymer-only and Fuel Excluded

CAA will review third-party certification using mass balance credit method, with allocations other than proportional, and accept only those which have an adequate method to ensure that allocation excludes use as fuel. The certification owner and their accredited certification bodies would be required to present their auditing process to the Advisory Board to demonstrate how fuel is verifiably excluded from the recycling process and that it complies with the criteria in the Act. Through this transparent and public process, only mass balance credit method certifications that meet the legislative requirements will be accepted.

After the first three years of implementation, CAA will publicly disclose in its annual report the amount of PCR qualified through mass balance credit method and the various allocation approaches to determine if further mechanisms are needed to verify PCR claims.

Non-certified PCR content will be subject to auditing by CAA Colorado in compliance with the CAA Colorado framework. This approach will include ensuring materials accounted for are postconsumer and not post-industrial recycled content. Producers using CAA Colorado-recognized third-party certification schemes will not be audited.

12.4 Increase PCR Rates and Provide Opportunity for Producers to Purchase PCR Materials

CAA Colorado considered the following items to providing producers opportunities to purchase PCR materials, which have also been informed by feedback from CAA Colorado's consultations process and advisory board:

- While similar measures were envisioned in other jurisdictions (e.g. Ontario, European Union), they have yet to be implemented.

- CAA Colorado does not have ownership of the recovered materials. CAA Colorado's consultations revealed that MRFs are only willing to consider CAA Colorado as one of the existing buyers.

- For some materials (metal, paper, glass), PCR is already regular practice. For plastic materials, differences exist between PET compared to other resins.

The approaches for providing producers the opportunity to purchase PCR is described below. CAA will continue to work with service providers and producers to explore additional approaches for increasing circularity of recycled materials.

PCR Incentives

MRF Incentives: CAA Colorado will work with participating MRFs to increase PCR availability to producers through various mechanisms in the MRF service agreements, including incentives for preferred REM and incentives to raise bale quality to levels expected by the preferred markets. Additional details on the service agreements are included in the *Operations Plan: Service Provider Reimbursement* Chapter. The main mechanisms include:

- **Additional Cost Factors:** The MRF reimbursement cost formula includes additional cost factors specifically for preferred end markets, which will be applied per ton of targeted commodity sold. The factor will be used to incentivize, using bonuses or penalties, MRFs to send materials to highest and best use end markets, circular end markets, local end markets, or other preferred locations. For example, the incentives could be used to direct materials to plastic reclaimers equipped to make food grade plastic packaging with PCR content. The MRF reimbursement cost formula will also include additional cost factors for bale

specifications and yield. These incentives can be used to encourage MRFs to produce bales that meet bale specifications for preferred markets.

- **MRF System Investments:** Service agreements will include terms for improving the capacity and efficiency of MRFs. This may include funding to allow MRFs to produce higher quality bales to meet preferable specifications.

Recyclers: CAA Colorado will consider offering incentives to recyclers to provide more PCR suitable for packaging applications (thus increasing supply) and use more PCR in their products (thus increasing demand) through the REM development process. A material availability gap study, detailed in the *Waivers* Section above, will allow CAA Colorado to define how to allocate funds for improving capacities, if needed. This data will inform how CAA Colorado can incentivize producers to use REM that return PCR to their original product type, as well as expand the capacity of these end markets to increase producer access to PCR to incorporate in their product design. More details can be found in *Operations Plan: Responsible End Markets* and *System Expansion* Chapters. CAA Colorado will:

- Assess the gaps between material supply and the PCR requirements for determining the right level of assistance.

- Consider providing end market incentives for PCR production and consumption according to the material availability gap study.

Opportunity to Purchase: As part of the service agreements with processors, CAA Colorado will evaluate including an optional mechanism that would provide producers with an ability to purchase material bales, focused initially on PET bales. The mechanism would provide an option for producers to make individual requests to purchase PET bales at market rates. Market rates will be based on a price index recognized by the industry. CAA Colorado would not seek to disrupt long term agreements that processors may have in place and would not directly purchase bales. Instead, the individual producer would become the buyer of the PET bales.

Data Sharing: CAA Colorado will track the destination of Colorado recyclables and share aggregated information with producers to enable them to purchase PCR for manufacturing. CAA Colorado will identify which end markets return PCR to their original product type and which Colorado-generated materials are sent to those end markets. CAA Colorado will support the connection of producers to these end markets to help them achieve their PCR goals by sharing data on locations, materials, and contacts. CAA Colorado's end market development will include seeking out and identifying end market opportunities that return PCR to their original packaging type. As additional materials are moved to MRL, CAA Colorado will work directly with processors and consider interventions to ensure processors have secure offtake opportunities for lower-value commodities

Incentivizing Producers to Use More PCR Content in Covered Materials: CAA Colorado will encourage the use of PCR by producers that go above the PCR targets through eco-modulation factors. More specifically, CAA Colorado will provide bonuses to incentivize producers that use PCR

above PCR eco-modulation thresholds. CAA Colorado intends to focus on materials for which it is harder technically and/or economically to incorporate PCR. These limitations will be identified in the material availability gap study. For clarity, a waiver may still be granted to producers for specific materials, but those producers who are able to exceed the target thresholds will be rewarded. Additional details on eco-modulation are included in the *Program Budget and Producer Dues* Chapter.

12.5 Evaluation and Continuous Improvement

Integral to increasing PCR use is periodic evaluation and continuous improvement of the methods and materials used. CAA Colorado plans on an ongoing basis to:

- Comply with the requirement to outline CAA Colorado's efforts to evaluate and monitor PCR in its Annual Report.

- Comply with the requirement to update the targets for each material. CAA Colorado will evaluate whether the Program's initial PCR targets should be updated based on the producer's reported data. If needed, CAA Colorado will work with the advisory board and CDPHE to adjust the targets to drive increased PCR use.

- Analyze PCR content rate data to inform and refine an approach that will better incentivize producers to use PCR in their packaging and expand REM opportunities that return PCR to their original product type.

- Conduct material availability gap research to ensure the approach remains current with the latest best practices.

- Collaborate regularly with producers to identify targeted PCR commodity needs for targeted incentives in MRF service agreements.

- Solicit feedback on the PCR verification process to ensure the framework is clear and not creating undue administrative burdens.

Based on these learnings, CAA Colorado will adjust its end market plan to achieve the PCR goals and desired outcomes.

13 Operations Plan: Responsible End Markets

Excerpt from the Act

25-17-702 (1)(g) a producer responsibility program in Colorado would: (VII) invest in recycling end market development and innovations that could attract new businesses to Colorado and create a more resilient domestic supply chain.

25-17-705 (4)(w) describe how the program will prioritize the use of end markets that return postconsumer recycled materials to their original product type.

25-17-705 (4)(x) describe how the organization will evaluate and monitor the use of responsible end markets through methods such as processor contracts or financial incentives. 25-17-709 (2)(a) The program report must include the following information from the preceding calendar year: (XI) a description of the organization's efforts to ensure that covered materials have been responsibly managed and delivered to responsible end markets under the program;(XII) a list of the recycling end markets of any covered materials.

With the influx of covered materials entering the marketplace, processors will need to ensure the materials they process meet required REM specifications. Producers will also require access to domestic and international REM to purchase PCR materials. This chapter describes how CAA Colorado will support end market development, ensure that recyclable packaging processed in Colorado are sold only to REM, and how CAA Colorado will oversee annual tracking and reporting.

CAA Colorado has three primary goals related to REM:

1. Ensure recovered materials are sold to REM.

2. Incentivize the use and development of REM that return postconsumer recycled materials to their original product type.

3. Invest in the development of REM and associated innovations that attract new businesses and create new jobs in Colorado.

To realize the goals listed above, CAA Colorado will work to achieve the following outcomes:

*   All collected materials have efficient and reliable pathways as commodities for REM use in making new products.

*   Recovered materials quality meets the desired REM specifications.

*   Sufficient REM capacity that can accept recovered materials and can grow with increasing collection volumes.

*   Programs and incentives that encourage new REM development and prioritize the use of REM that return PCR materials to their original packaging type.

*   CAA Colorado is seen as a valued and trusted collaborator among state, regional, and national programs and organizations that are actively involved in REM development.

- New end markets are established for covered materials, allowing MRL and AML to continue to expand over time.

Leveraging data and information gathered to date, CAA Colorado will use the following guiding principles to develop a REM plan for Colorado:

- Leverage work from other organizations to optimize resources and reduce the administrative burden on MRFs and REM.

- Collaborate with organizations across the recycling value chain, including brokers, organizations, and programs actively involved in REM development.

- Leverage CAA Colorado's national REM efforts to tailor a Colorado-specific approach.

- Focus on addressing the barriers Colorado processors experience when accessing REM, including the use of contracts and financial incentives to help processors meet the supply-side requirements that end markets demand.

- Incentivize the growth of local REM capacity while recognizing that many processors have existing relationships with REM outside Colorado.

- CAA Colorado will not forbid REM access based on the type of technologies used to transform recyclable materials into a product, provided the process used is deemed responsible and meets Colorado law.

- CAA Colorado strives to be transparent, while recognizing the release of proprietary information would be a market impediment.

13.1 End Market Evaluation and Verification

The following implementation process details how CAA Colorado will use the guiding principles to achieve the Act's goals, organized around end market evaluation, verification, and development.

CAA Colorado will deploy a detailed REM verification standard, developed with support of an ANSI-accredited standard development body, with specific criteria, performance indicators, and non-compliance protocol. The development process will include public consultation, governmental involvement (including CDPHE), and a balance of interest holders on the standard development committee. CAA Colorado will update the Advisory Board and CDPHE on the standard development process. The REM verification standard will be harmonized, as much as possible, with those from other states to create Program efficiencies and reduce the burden on REM and processors. Responsible end market is defined in the Act as a materials market in which the recycling of materials or the disposal of contaminants is conducted in a way that benefits the environment and minimizes risks to public health and worker safety. A summary of CAA Colorado's approach to REM verification is provided below. Additional details can be found in the *End Markets* Appendix.

CAA Colorado's end market verification approach contains four key steps:

1. Initial screening
2. Data review
3. Entity verification
4. Monitoring

Initial Screening

The participating processor will be responsible for identifying the end markets to whom they send materials. Each end market will initially be assessed via a self-attestation form submitted to CAA Colorado by either the participating processor or directly from the end market business. At the time of the submission, CAA Colorado will also request additional data from the end market.

Data Review

At a minimum, CAA Colorado will request end market entities to provide operating or environmental permits, status of compliance with relevant state and federal laws, licenses and, in the case of overseas markets, import permits or authorizations.

CAA Colorado will request that end market entities list active certifications and/or verifications related to recycling processes, facility management systems, or other elements covered by REM verification criteria. Based on this information, CAA Colorado may request additional data related to environmental protection, public health, and worker safety to address identified risks.

For those end market entities that process materials through a method other than mechanical recycling, CAA Colorado will request additional data as required by the Act, including:

- Description of how the method will affect the ability to recycle the covered material into feedstock.

- Description of how the method will increase the types and amounts of recycled plastic for food and pharmaceutical-grade packaging.

- Description of any applicable state or federal air, water, and waste permitting compliance requirements.

- An analysis of the environmental impacts of the methods compared to the environmental impacts of incineration of solid waste.

Entity Verification

Based on the initial screening and data review, CAA Colorado will determine which end market entities require a full or partial REM audit, or no audit, against the detailed REM Verification Standard, once it is complete. Prior to adoption of the REM Verification Standard, CAA Colorado will consider end markets that successfully complete steps one and two as a conditionally verified REM. End markets located outside the United States may be prioritized for full REM audits, especially in the years immediately following Program approval. Audits of local, national, or

international end markets, as well as the frequency of these audits, will ultimately be prioritized based on the information provided through the initial screening and the subsequent risk analysis. CAA Colorado expects that auditing will be undertaken by a third party.

Audits will be on a pass/fail basis. For end market entities that fail, a corrective action plan for each area of non-compliance will be provided. CAA Colorado plans to harmonize its REM verification approach across the states in which CAA Colorado operates, resulting in concurrent REM verification for multiple states, through the development of the REM Verification Standard.

Verification Standard

To develop an effective verification standard, CAA Colorado will conduct a benchmarking exercise of existing standards. CAA Colorado's initial approach will focus on four key topics:

1. Legal and regulatory compliance

2. Health and safety

3. Environmental protection

4. Transparency

CAA Colorado will explore opportunities to test this standard with volunteer end market entities and will also seek guidance from CDPHE before finalizing the list of verification standard. CAA Colorado's Annual Report will include a list of the end markets and whether they use a method other than mechanical recycling.

Monitoring

End market entities that pass the verification process will continue to be monitored through periodic reporting to CAA Colorado, which may include recurring audits based on risk profile. CAA Colorado will also act if there is evidence that a previously verified entity may be non-compliant, up to and including an on-site REM audit. CAA Colorado will also continue to work with processors to identify any developing or new end markets that may require verification. CAA Colorado's Annual Report will list any end markets for covered material with additional details, if the end market does not use mechanical recycling.

Post collection service agreements with CAA will include force majeure language to account for unforeseeable circumstances that may require commodities to go to a non-verified REM for a limited time.

13.2 End Market Development

Recycling end market development entails a systematic approach, as described in Figure 6 below. This section will summarize how past research has informed CAA Colorado's end market development approach.

Figure 6: End Market Development Process
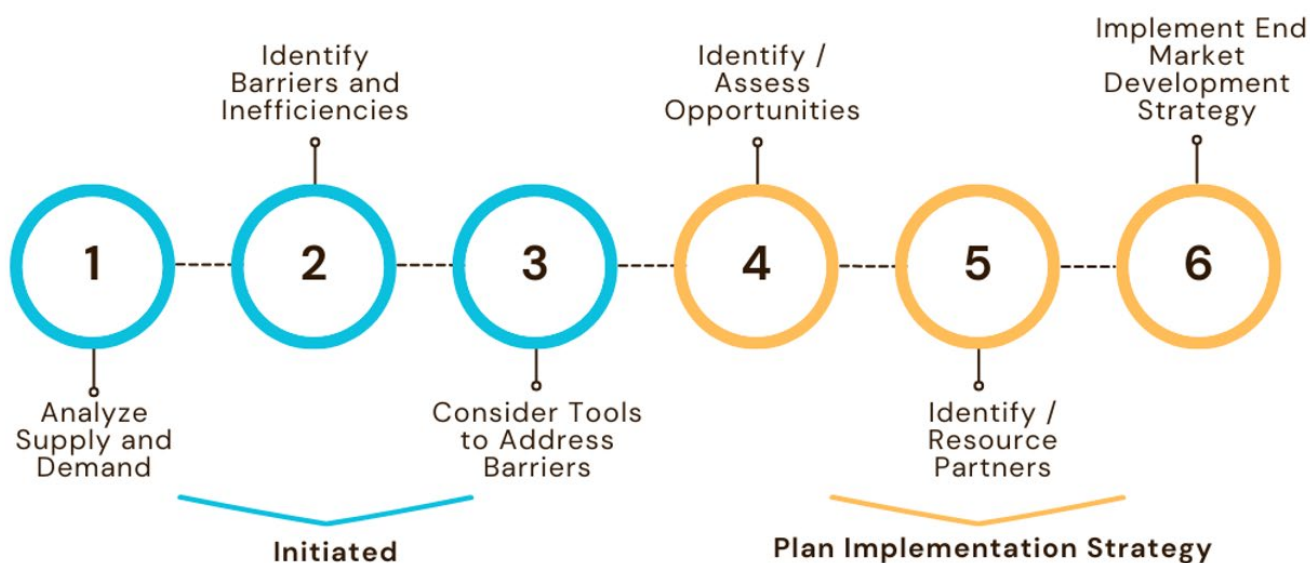
Analyze Supply and Demand

As part of the Needs Assessment, CAA Colorado conducted primary and secondary research to understand the availability and capacity of end markets in Colorado. Having one or more end markets is one of three criteria required by the Act for materials on the MRL and AML[45]. Consequently, materials selected by CAA Colorado for inclusion on MRL were determined to have adequate end markets.

However, supply-side barriers associated with aggregating and preparing these materials to meet REM needs may still exist. Many of these barriers could apply to multiple materials, such as barriers in moving material efficiently from the rural regions in Colorado and reducing contamination in the recycling stream.

Therefore, CAA Colorado will focus REM development efforts on AML and MRL materials, with plans to develop a material priority influenced by recyclability pathways and whether all Colorado processors have adequate access to end markets for MRL materials. For materials deemed unmarketable in the near-term, CAA Colorado will rely on the proposed eco-modulation framework to incentivize design for recyclability and will continue to evaluate the need for new innovations in primary or secondary processing. More details can be found in the *Eco-Modulation Approach* Chapter.

Recognizing that circumstances will change over time, CAA Colorado will explore conducting future supply and demand assessments and evaluate recycling market development initiatives undertaken for all future Program updates.

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[45] 25-17-706 (1) (a)

Identify Barriers, Consider Potential Tools to Address Barriers

Colorado is confronted with a variety of barriers to recycling market development, which include:

- High transaction costs due to geography (e.g. distance to ports, mountains separating MRFs from key end markets, rural nature of much of Colorado and surrounding states)

- Low solid waste tipping fees

- Relatively small manufacturing base that limits the existence of in-state markets

- Technology limitations

- Market risk and volatility

- Challenges reaching economies of scale

CAA Colorado will explore known program and policy tools to overcome these barriers, including:

- CAA Colorado-provided technical assistance, creating best practice guidance, linking market players with available resources, developing model PCR procurement contracts, and disseminating accurate market data to address uncertainties.

- Hiring third-party consultants to perform material-specific research.

- Investing in promotional campaigns, education and outreach materials and initiatives, and systems to link processers and end users, including producers seeking PCR.

- Incentives for processors to accept materials beyond MRL as readily accessible end markets for non-MRL materials are identified.

- Incentives for supporting outbound quality at processing facilities.

- Financial assistance and incentives to develop secondary processing operations and incentivize downstream system enhancements as needed.

- Financial assistance, in collaboration with other organizations, to resolve known end market barriers, to de-risk end market opportunities, or to support innovative end market solutions.

Identify Opportunities for End Market Development

CAA Colorado recognizes the following key considerations in evaluating end market development opportunities:

- Ability to influence markets, particularly in sustaining existing end markets and growing new markets for materials in Colorado

- Ability to divert substantial material from disposal

- Ability to quickly implement a solution

- Availability of potential collaborators and implementation resources

- Ability to return PCR to their original product type

Identify Resources and Collaborators

Recognizing that recycling market development efforts can only be successful with complementary public and private sector programs, CAA Colorado will explore collaborations including:

- Collecting and sharing material-specific data that can link Colorado suppliers with REM, informing them of opportunities for establishing new or expanding existing end markets.

- Prioritizing opportunities for end markets that return PCR to its original product type.

- Joining state, regional, and national efforts to support REM innovations and implement solutions to market barriers.

- Growing demand for Colorado-sourced PCR by promoting its use as feedstock in manufacturing and promote the purchase of products made from Colorado PCR content. This might include increasing the capacity of existing PCR users to take additional Colorado-sourced PCR, encouraging manufacturers using virgin or post-industrial feedstocks to convert to Colorado PCR, and encouraging the establishment of new REM in Colorado.

- Creating a multi-state approach for REM development for specific materials that have unique national market development needs. This approach might include identifying the need for secondary processing facilities to sort mixtures of materials or assuring sufficient capacity exists and is protected from excessive market risk. It will be imperative to pursue opportunities that integrate CAA Colorado with regional and national programs and organizations to help realize this goal while staying informed of other recycling market development efforts to harmonize and integrate.

The *Organizations Involved in Recycling Market Development – National and EPR States* Appendix contains a list of national organizations that could serve as potential CAA Colorado collaborators. Many of these organizations are already heavily investing in REM development activities, especially in the plastics sector. These will be important relationships for CAA Colorado to foster as a national recycling market development policy is created.

Equally important is to foster relationships with potential Colorado-based collaborators who are actively working to build the circular economy. CAA Colorado will engage with these organizations to establish and grow existing Colorado-based end markets. Provided in *Organizations Involved in Recycling Market Development – Colorado Appendix* is a list of state organizations that could serve as potential CAA Colorado collaborators.

Phased Approach

It will take time to coalesce around a recycling market development plan that recognizes both Colorado's needs and CAA Colorado's interest in creating national end market alignment. CAA Colorado therefore proposes a three-phase approach to implementing REM development.

Phase 1 – Program Start-Up (2025–2026)

a. Finalize the REM evaluation and verification details.

b. Finalize the list of material for which interventions will be targeted in priority, to guide REM development activities. An initial list is included in the *System Expansion* Chapter.

c. Finalize a national recycling market development policy identifying the tools and policies that will be implemented, harmonizing the approach to REM development across EPR states.

d. Identify and establish relationships with state, regional, and national programs and organizations that are actively pursuing REM development opportunities.

Phase 2 – Transition to EPR System (2026–2027)

a. Begin verifying REM and data collection.

b. As service provider cost reimbursement agreements are negotiated, establish terms and conditions to improve sorting and reduce contamination to best align with REM specifications.

c. Collaborate with programs to pursue REM development opportunities and innovations, guided by both the material priority and a prioritization of end markets that return PCR materials to their original product type.

d. Drive demand for Colorado-sourced PCR by promoting its use as feedstock in manufacturing and promoting the purchase of end products made from Colorado PCR.

e. Align the eco-modulation framework with REM development efforts to encourage producers to consider REM in the packaging design.

Phase 3 – Ongoing Activities (2028–2030)

a. Conduct periodic REM monitoring and auditing.

b. Identify new material-specific opportunities to expand MRL and AML in the updated Needs Assessment.

c. Collaborate with programs to pursue REM development opportunities and innovations, guided by both the material priority and a prioritization of end markets that return PCR materials to their original product type.

d. Drive demand for Colorado-sourced PCR by promoting its use as feedstock in manufacturing and promoting the purchase of end products made from Colorado PCR.

Evaluation and Continuous Improvement

Evaluation and continuous improvement of the methods and materials used will be integral to the success of REM. On an ongoing basis, CAA Colorado will:

a. Describe CAA Colorado's efforts to evaluate and monitor REM in the Annual Report.

b. Provide a list of known REM with additional details on those that rely on non-mechanical processes in the Annual Report, helping to inform future MRL revisions as well as guiding investment to expand REM access for materials not on MRL.

c. Analyze collection and recycling rate data to identify materials that are persistently below targets and prioritize REM solutions to meet targets.

d. Analyze supply data and changes to assess the effectiveness of the eco-modulation incentives, consider opportunities to adjust incentives to achieve program goals.

e. Analyze PCR rate data to inform an approach that better incentivizes producers to use PCR in their packaging and expand end market opportunities that return PCR to their original product type.

f. Analyze contamination data provided by service providers to inform opportunities for supply-side investment to meet REM specifications.

g. Conduct research on REM evaluation and verification processes to ensure the framework remains current with the latest best practices.

h. Solicit feedback on REM evaluation and verification process to ensure the framework is clear and does not create undue administrative burdens.

i. Collect data on the economic impact of new and expanded Colorado-based REM to document the benefits of EPR to Colorado's economy.

j. In cases where CAA Colorado enters into a formal agreement with an organization to pursue a joint REM development project, monitor the performance to ensure project milestones, deliverables, and the desired outcomes are achieved.

Based on these program evaluation learnings, CAA Colorado will adjust its REM plan to achieve its goals and desired outcomes.

14 System Expansion

Th Program's aims go well beyond simply reimbursing existing service providers. CAA Colorado must also expand services, increase access, and improve overall system performance to achieve the Act's objectives. CAA Colorado will use various means to expand the system to meet the 2030 and 2035 collection and recycling rate targets including service agreements and performance-based incentives, a System Development Fund, education and outreach campaigns, and industry collaboration. This chapter describes CAA Colorado's proposed approach for expanding services to non-residential covered entities, transitioning covered materials to MRL, and investing in system expansion.

CAA Colorado's preferred approach to working with service providers is to invest in recycling infrastructure and market development through long-term contracts for reimbursement. However, CAA Colorado recognizes that this approach may leave gaps in the recycling system that requires up-front capital. For example, there may be higher-risk infrastructure projects that might require seed capital to prove the reliability required by commercial lenders. CAA Colorado will establish the System Development Fund to deploy grants that are tailored towards projects that may benefit Colorado's recycling system, assist recycling in low-volume or low-population areas, or foster market development for covered materials.

One area of future system expansion relates to non-residential covered entities. The table below lists and defines non-residential covered entities.

Table 27: Definitions of Non-Residential Covered Entities

Entity	Definition
Hospitality Locations	Visitor accommodations such as hotels and motels, campgrounds, event venues, stadiums, food and drink establishments that predominantly generate the same types of covered materials as residential covered entities.
Public Places	Indoor or outdoor locations where trash services are offered in the state that are open to the public; includes streets, sidewalks, plazas, town squares; state-owned or local-government-owned parks, beaches and forests, other state owned or local-government-owned land open for recreation or other public uses, transportation facilities, including bus and train stations and airports. Does not include industrial, commercial, or privately-owned property.

Schools	A public school in the state that enrolls students in any grade kindergarten through twelfth grade, including a traditional public school of a school district; a charter school of a school district; an institute charter school; or an approved facility school, as defined in section 22-2-402 (1); or a nonpublic school that enrolls students in any of grades kindergarten through twelfth grade. "Approved facility school" means an educational program that is operated by a facility to provide educational services to students placed in the facility and that, pursuant to section 22-2-407 (2), has been placed on the State's list of facility schools that are approved to receive reimbursement for providing educational services to students placed in a facility.
Small Businesses	Individual business at a physical business location that has less than the total annual gross sales as adjusted annually by the Consumer Price Index as specified in Section 1.8.2 of CDPHE's Regulations Pertaining to Solid Waste Sites and Facilities. As of 2025 the annual gross sales limit is less than $5,632,843 in realized gross total revenue, not including on-premises alcohol sales, during the prior calendar year.
State and Local Government Buildings	Structures occupied by any person which are either owned by a local government or the state or utilized by a local government or the state through leases of one year of duration or longer.

14.1 Expand Recycling Services to Applicable Non-Residential Covered Entities

> **Excerpt from the Act**
> 25-17-705 (4)(z) Describe a process and timeline, beginning no later than 2028, to expand recycling services to applicable non-residential covered entities, as identified in the needs assessment pursuant to subsection (3)(a)(v) of this section

At Program launch, CAA Colorado will not be reimbursing recycling services to non-residential entities. Instead, CAA Colorado will start reimbursing servicing of non-residential covered entities in 2028, and – in close consultation with service providers and non-residential entities – will phase in reimbursement for existing services and collaborate with service providers for service expansion.

In addition to service providers, CAA Colorado plans to collaborate closely with CDPHE and local governments to educate the managers and operators of non-residential covered entities on the Program, including covered materials, and how to access services and reimbursement. CAA Colorado will conduct studies and analyses that further identify eligible non-residential covered entities described in Table 27.
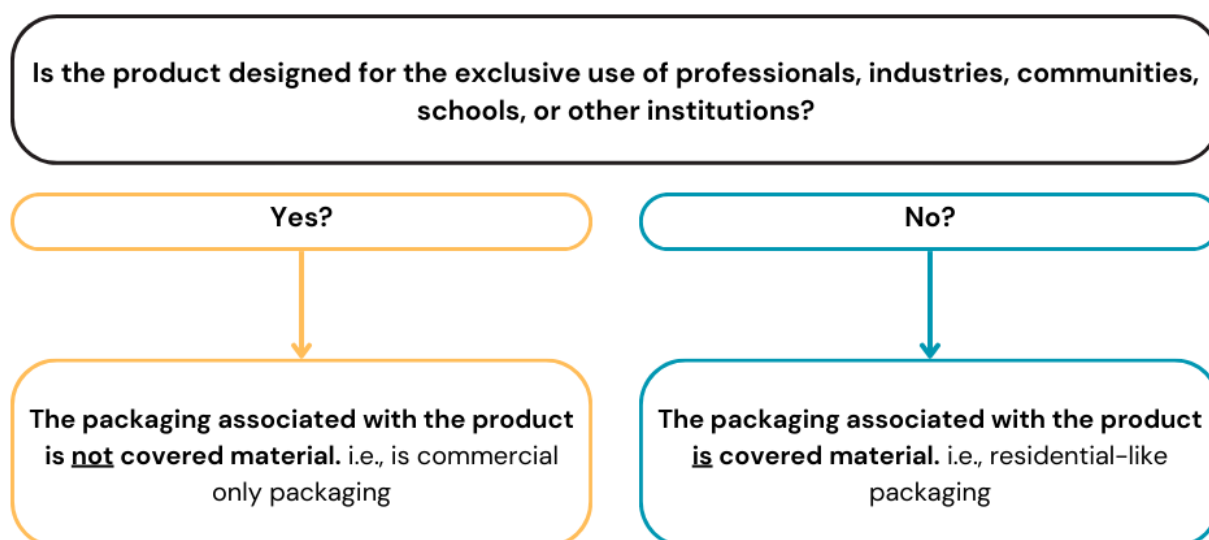
Covered Materials at Non-Residential Covered Entities

CAA Colorado proposes to reimburse the costs for non-residential covered entities' recycling services. However, this reimbursement requires CAA Colorado to distinguish between the many types of materials generated at non-residential entities. For example, commercial and industrial packaging waste is not considered household packaging waste and is not within the scope of the Program. Packaging waste will not be considered covered material if it is from a product used exclusively for professionals, industries, schools, or institutions. In this context, non-covered materials include those:

- Used solely in transportation or distribution to non-consumers.

- Used solely in business-to-business transactions where the covered material is not intended to be distributed to the end consumer[46].

- Not sold or distributed to covered entities.

- Described as exempt in the *Operations Plan: Material Strategy* Chapter.

To determine if material used at a non-residential entity is covered, the following diagram is an example of the decision pathway.

Figure 7: Non-Residential Packaging Covered Material Decision Tree

CAA Colorado will develop and publish guidance on residential-like materials to assist producers in differentiating covered materials from non-covered commercial and industrial packaging waste. In doing so, this guidance will consider the properties of the packaging (size, quantity of product,

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[46] A consumer is defined as any person who purchases or receives covered materials in the state and is located at a covered entity.

type of product supplied), as well as the intended use of the packaging, which helps to define the types of non-residential entities eligible for reimbursement. This may also influence the containers and collection models used for reimbursement of non-residential collection. CAA Colorado will also establish guidance on service level standards for which compensation will be provided.

Phased Implementation Approach

CAA Colorado's phased approach for reimbursement for existing services and expansion of non-residential covered entity services allows CAA Colorado, service providers, producers, and others to find mutually agreeable solutions to the challenges of isolating recycling services and costs for non-residential reimbursement. Like the challenge described for collection of multifamily residences in the *Operations Plan: Service Provider Reimbursement* Chapter, many commercial collection routes serve both covered and non-covered entities, potentially providing collection for both covered and non-covered materials in the same collection vehicle and container. This may require changes to service provision and data tracking.

The proposed phased approach is described below.

Pre-Implementation (2025 – 2028)

- CAA Colorado will conduct waste composition studies on materials collected from covered non-residential entities to inform any cost formulas needed for non-residential recycling. Cost formulas will be based on those described in the *Operations Plan: Service Provider Reimbursement* Chapter but may be influenced by both the mix of covered and noncovered entities on routes and the proportion of residential-like covered materials mixed with non-covered materials.

- CAA Colorado will collaborate with collection service providers to analyze collection routes to determine potential efficiencies for non-residential collection.

- CAA Colorado will collaborate with collection service providers to determine the most appropriate containers for collecting residential-like material from non-residential entities.

- CAA Colorado will collaborate with service providers, property managers, local governments, and other parties to determine the most effective way for reimbursement of service providers without billing covered entities. This will be aligned with the RFR process articulated in the *Operations Plan: Recycling Services Approach* and *Operations Plan: Service Provider Reimbursement* Chapters. Additional steps or actions might be needed for non-residential entities, such as an application process for reimbursement.

- Informed by the waste composition studies, CAA Colorado will develop a policy that further identifies eligible non-residential covered entities and that will assist in the launch and ongoing expansion phases, in consultation with CDPHE. Further definition may be required, but not limited, to the following:
  - Local or State Government Buildings

- Reimbursement for recycling services for structures wholly occupied and owned or utilized by a local government or the state through leases of one year of duration or longer.

- Define and determine reimbursement eligibility based on those that have public access compared to those that do not have public access and do not generate substantial amounts of residential-like covered materials. (e.g., not entirely office space, labs, wastewater treatment, public works buildings).

- Determine how to integrate with reimbursement of municipal and contracted collection models (if applicable).

- Hospitality Venues

  - Define hospitality location eligibility based on the amount of residential-like material generated and/or ownership structure.

  - Define and determine stadium eligibility, potentially based on the number of seats, ownership, collection, or other factors.

  - Define events and festivals eligibility based on having staffed or unstaffed waste sorting stations and other considerations.

  - Define and determine food and drink establishment eligibility based on the amount of residential-like material generated and/or ownership structure such as independent, franchise, or chain.

- Small Business

  - Define and determine small business eligibility by North American Industry Classification System (NAICS) codes, employee size, revenue, types of materials generated, and/or fully occupying a commercial location that does not share collection with other entities.

- Public Places

  - Define and determine public place eligibility based on convenience standards and require the use of twinned trash and recycling bins.

Implementation and Ongoing (2028+)

In 2028, CAA Colorado will begin to implement reimbursement of recycling costs for non-residential covered entities. CAA Colorado's communication of availability of non-residential reimbursements will be paired with requests for servicing municipal and open market collection as described in the *Operations Plan: Service Provider Reimbursement* Chapter. The phased rollout of reimbursement shown in the table below is subject to change and based on the definition of non-residential entities as described above.

Table 28: Non-Residential Entity Reimbursement Approach

Year	Action	Proposed Reimbursement Approach
2028	Begin implementing reimbursement for schools.	Actual or modeled costs, reimbursement directly to schools.
Prior to 2030	Begin implementing reimbursement for local and state government buildings, and public places.	Reimbursement directly to local government.
2030	Begin implementing reimbursement for hospitality locations and small businesses.	Reimbursement to service provider, potential for need to reimburse directly to the non-residential entity in some cases.

Process for Evaluation and Revision of Non-Residential Recycling

CAA Colorado will periodically undertake collection studies and waste composition analysis to assess the effectiveness of non-residential covered entity collection, and to determine current collection costs, compare the composition of residential-like to industrial covered materials and compare current to historical. Additionally, CAA Colorado material characterization audits will evaluate the levels of contamination to identify interventions including targeted education and outreach campaigns.

14.2 Transitioning Additional Covered Materials to the Minimum Recyclable List

Excerpt from the Act
25-17-705 (4)(i) Establish a funding mechanism that: (VI) At the request of a producer or producers of a covered material, may include a special assessment paid by the producers of that covered material to cover system improvements that improve the collection and recycling of that covered material or facilitate the addition of the covered material to the list of readily recyclable materials

One of the ways CAA Colorado will be able to meet and improve the state's minimum recycling rates is to progress covered materials from AML to MRL. CAA Colorado will work with producers and service providers to remove barriers that restrict recyclability through a combination of targeted investments, new or improved infrastructure, end market development, and packaging and product design changes.

The Needs Assessment identified several such barriers, including collection challenges, sorting issues, end market acceptance, and material detrimental to recycling other covered materials. Initially, CAA Colorado will use the Needs Assessment criteria as the basis for transitioning material from AML to MRL and if a special assessment is issued for covered materials not on the AML. CAA

Colorado also acknowledges that specific materials may require targeted actions to transition to MRL and collect in a manner as convenient as the collection of solid waste.

Pathways to Transition

CAA Colorado has identified pathways for each material on the AML to transition to the MRL, described below. CAA Colorado may begin with a pilot in a targeted geographic area, MRF, or market zone to test the pathways efficacy and provide learnings to the marketplace prior to statewide implementation.

- **MRF Improvements:** CAA Colorado will work with MRFs to encourage improvements (equipment or facility upgrades) that will allow for more types of materials to be processed and sold. MRF improvements will be identified during the RFR process, with costs recovered through reimbursement. CAA Colorado will also provide incentives for MRFs to make improvements to facilitate acceptance of AML materials. If needed, CAA will consider provisions in service agreements with MRFs to allow for flexibility in verified REM requirements in reimbursements when new materials are being on-boarded.

- **Drop-Off Improvements:** CAA Colorado will support drop-off infrastructure for materials not currently accepted in MRFs. CAA Colorado will improve the existing drop-off infrastructure for AML material, and work with service providers to develop new drop-off facilities to accept materials where needed. As more material is amassed, and pilot studies are conducted, drop-off expansion may be an interim step before moving materials to curbside collection.

- **End Market Improvements:** CAA Colorado will work with MRFs to identify REM for the materials and ensure acceptance of the material.

- **Product Design Improvements:** Consultations with service providers, MRFs, and end markets suggested that packaging design change may be needed to successfully sort and market AML material. CAA Colorado will consider incentivizing improved product design for these materials through producer dues, producer guidance on recyclability, and eco-modulation.

- **Collection:** As upgrades are made to accept more materials at MRFs, CAA Colorado will work with collectors to expand the materials they are collecting and work to ensure residents are informed.

- **Education and Outreach:** CAA Colorado will update the MRL on an annual basis, with changes promoted through statewide, local, and special education and outreach campaigns.

- **Eco-Modulation:** CAA Colorado will work with CDPHE to implement eco-modulation bonuses to influence product or packaging design choices.

- **Recyclability Guidance:** To both improve the recovery of materials and support the migration of materials to MRL, CAA Colorado anticipates sharing additional recycling guidance with producers that would be aimed at helping guide product design choices to increase recyclability. Guidance may include recommended design choices published by trade organizations such as Association of Plastic Recyclers, American Forest and Paper Association, Glass Packaging Institute, Can Manufacturers Institute, as well as specific evidence-based guidance published by CAA Colorado.

Approach

CAA Colorado recognizes that there are packaging materials on the AML with similar material compositions and recyclability challenges that might result in groups of like materials being transitioned from the AML to MRL in a cost-effective manner. When possible, CAA Colorado will address groupings based on the transition pathway, the level of investment required by service providers to collect and process the material, and by available acceptance of the material in responsible end markets. Close collaboration with MRFs will be required to accept these materials for sorting and marketing.

Material groups, existing market conditions, and the approach to the AML to MRL transition are described in the table below.

Table 29: Transitioning Materials from AML to MRL

AML Materials	Existing Considerations	Potential Approaches
Paper – Small Format	- Small format paper (e.g. hand tags, receipts, at home shredding) - Currently collected at drop-off (limited) and through shredding companies - Small format paper cannot be processed at a MRF when collected in single stream - Some MRFs can accept this material from a source-separated program	- Support the existing municipal drop-off of residential-like shredded paper and small format paper. - Support collection and post-collection service providers to implement shredded paper and other small formats in drop-off programs

• HDPE Colored Nursery Containers • PP Colored Nursery Containers	• Minimal collection in drop-off and curbside programs • MRF optical sorters are unable to detect black resins	• Support collection of nursery containers through drop-off programs • Collaborate with MRFs to determine costs of handling black plastics across all rigid plastic resins • Work with MRFs to improve sorting technologies • Potential to incentivize product design changes through eco-modulation and recyclability guidance
• Other Aluminum Packaging (Foil and Foil Trays) • Other Metal Packaging	• Collected by drop-off sites or curbside programs • Commonly managed by MRFs despite neither explicit nor implicit acceptance • Quality control sorting (other aluminum) required to ensure used beverage can (UBC) bale quality	• Continuing to support drop-off and curbside collection of this packaging • Work with MRFs through RFR process to inform the timing of transition to curbside collection

• Molded Pulp Food Service ware • Paper Cups, Coated and Uncoated • Other Poly-coated Packaging (e.g., some freezer and butter boxes) • Paper "cans" (spiral-wound containers with steel or plastic ends)	• Commonly being managed by MRFs despite neither explicit nor implicit acceptance • Spiral wound paper cans are generally not accepted today • Not all MRFs are equipped to sort to the target baled outputs • Challenges include residue contamination, packaging dimensions thar result in polycoated packaging in both paper and container lines, plastic and paper combined in the packaging, and end market acceptance	• MRF RFR process will inform the timing of transition to curbside collection • If needed, conduct research to better determine costs and deployment pathways at MRFs; may include material flow study, sorting study, and/or cost benefit analyses • End market development and collaboration may also be required to ensure offtake pathways
• Colored Opaque PET Bottles, Jars, and Jugs • Colored Opaque PET Thermoform Containers • PET Other Rigid	• Commonly managed by MRFs despite neither explicit nor implicit acceptance • Current optical sorters are unable to detect black resins • Limited end market demand for colored PET • End market challenges for PET Thermoforms • PET Other rigid objects such as clothing hangers, tags, and clips can be difficult to sort due to material characteristics	• MRF RFR process will inform the timing of transition to curbside collection • If needed, conduct research to better determine costs and deployment pathways at MRFs; may include material flow study, sorting study, and cost benefit analyses • End market development support may be required

• LDPE (#4) Bottles Jugs and Jars • LDPE (#4) Other Rigid	• Commonly managed by MRFs despite neither explicit nor implicit acceptance • Limited end market demand for LDPE	• MRF RFR process will inform the timing of transition to curbside collection • If needed, conduct research to better determine costs and deployment pathways at MRFs; may include material flow study, sorting study, and cost benefit analyses • End market development support may be required
Polyethylene Squeeze Tubes (e.g., toothpaste, lotions, sunscreens)	Limited acceptance in curbside or drop-off programs	• MRF RFR process will inform the timing of transition to curbside collection • If needed, conduct research to better determine costs and deployment pathways at MRFs; may include material flow study, sorting study, and / or cost benefit analyses • Verification of material acceptance by the REM • Potential target for incentivizing product design changes through eco-modulation and recyclability guidance; Association of Plastic Recyclers (APR) provides design guidance for tubes to be sorted with the colored HDPE

LDPE or HDPE Film (e.g., monoPE recycle-compatible pouches)	• Collected through take-back programs • Very few municipal drop-off programs accept these materials • No collection via curbside	• Maintain drop-off take-back, and supplemental collection infrastructure • Use the outputs of the MRF RFR process to inform the timing for curbside collection and processing • Consider pilot project(s) to quantify the collection, processing, and marketing flexible plastic packaging prior to statewide intervention • Collaborate with downstream markets for acceptance in recycled polyethylene market • Potential target for incentivizing product design changes through eco-modulation and recyclability guidance
White Expanded Polystyrene	• No curbside collection programs • Limited drop-off options • Colorado MRFs generally do not want to manage these materials in single or dual stream	Maintain and expand drop-off infrastructure
Paper Laminate (e.g., paper/aluminum wrappers, poly-lined deli wrap, and other plastic coated paper wrappers)	• Not accepted in drop-off or curbside collection programs • May produce low fiber yield when pulped in a typical board pulping process	• Product design improvements are required before the material can be considered for curbside collection • Collaborate with end markets and producers transitioning to more pulpable designs to determine end market acceptance

CAA Colorado will collaborate with service providers and the producers of non-MRL covered material to work on the recyclability challenges identified in the Needs Assessment. The *AML Pathways to MRL* Appendix provides further insight into each packaging material on the AML, and recommended pathways to MRL.

The Act provides a pathway for producers of other covered materials to fund the addition of future materials to MRL. At the request of a producer or producers of a covered material, CAA Colorado can establish a funding mechanism that may include a special assessment paid by the producers of that covered material to cover system improvements that improve the collection and recycling of that covered material or facilitate the addition of the covered material to MRL. This could include a series of projects that are needed to improve the recyclability of covered materials. These projects could include any combination of:

- Educating covered entities on new recycling services
- Material flow and sorting studies within MRFs
- Acceptance of the packaging by end markets
- Implementing a material-specific collection program
- Funding infrastructure improvements to allow for more efficient processing of the material

Non-Recyclable Materials: The Needs Assessment's medium scenario included a goal for the collection of 'hard to recycle packaging' in Colorado via drop-off or events by 2030. To achieve this aim, CAA Colorado will collaborate with service providers, end markets, producers, and other interest holders to develop pathways for materials that are not currently collected to enable the transition of eligible materials from the non-recyclable category to the AML. CAA Colorado will utilize the data collected through material audits, gap studies, and service agreements during the first two program years to identify viable pathways for material transition by 2030. CAA Colorado will include updates in the annual reports to ensure eligible materials can be collected in some form by 2030.

14.3 Investing in Recycling Infrastructure and End Markets

> **Excerpt from the Act**
> 25-17-705 (4)(u) Describe how the organization will work with service providers to: (III) Invest in new or upgraded recycling infrastructure;
> 25-17-705(4) (u) Describe how the organization will work with service providers to: (VI) Invest in market development for covered materials in the state;

Contractual Approach to Investment

The Needs Assessment evaluated existing recycling infrastructure in Colorado and determined that additional capital is needed to consolidate and process MRL and AML materials. The full

deployment of EPR in Colorado may result in 450,000 to 750,000 additional tons of MRL and AML materials to collect and process, thus requiring new recycling infrastructure.

CAA Colorado's approach to investing in recycling infrastructure is to rely on collection and post-collection service providers to make decisions needed to satisfy reimbursement agreements. This could include infrastructure that increases efficiency, volume of materials processed, quality of materials processed, and pricing for processing of MRL and AML materials. Under this approach, CAA Colorado would not provide up-front capital funding but instead rely on service providers to secure capital for upgrades. CAA Colorado would pay for the investments through service agreements designed to allow service providers to recoup their costs. The objectives of this contractual approach are to:

- Allow service providers to develop innovative and cost-effective solutions for collection and post-collections service.

- Align CAA Colorado and service providers' focus on improved outcomes as opposed to satisfying a grant or capital fund process.

- Provide service providers with long-term stability.

- Reduce CAA Colorado's administrative burden, as service agreements would set performance standards with limited requirements for how facilities achieve those standards.

Individual service providers would sign service agreements for reimbursement, requiring them to achieve defined performance metrics with limited assistance from CAA Colorado for meeting those metrics. Contracts may include performance standards for collection, transfer, materials processed, bale quality, residue quantities, safety, maintenance, efficiency, and marketing material to REM. CAA Colorado will also consider incentivizing improvements by paying a higher reimbursement per unit (e.g., household, ton) based on improved performance, with terms, conditions, and values being contract specific. Refer to the *Operations Plan: Service Provider Reimbursement* Chapter for more details.

System Development Fund

During the first year of Program implementation, CAA Colorado will seek to identify specific service gaps in collection, post-collection, and end market development. The organization will collect data and then establish a detailed policy and evaluation process for grants. The System Development Fund process and investments will be included in the annual report that will be presented to the Advisory Board and CDPHE. Based on the identified system gaps, CAA Colorado will begin addressing these gaps through the Fund or through other means after the Program's first year. The scale of the System Development Fund will be dependent on the RFR process, the processors and collectors that choose to participate in the program and their specific needs, ongoing assessment of market gaps, and annual evaluations of progress toward program goals. This approach is secondary to the contractual approach investment and will be used to fill system gaps. Initially, CAA Colorado will prioritize deployment of system development fund in areas that are most in need of

collection or processing infrastructure, including rural areas of the state. Areas of consideration for the Fund may include:

- Drop-Off: Even with a contractual relationship, some communities may need upfront capital to establish drop-off sites that expand recycling access.

- Transfer Facilities: There may be strategic locations for transfer facilities that provide more efficient collection services.

- Rural Infrastructure: Service providers in low volume and/or low population areas in Colorado that may need upfront capital to establish or expand recycling services. Additionally, there are smaller MRFs and push and bale facilities that may extract specific materials and feed remaining materials to Front Range MRFs for further processing. The Fund could assist the purchase of equipment for sorting, consolidation, and preparation of material to be sent to MRFs or transfer facilities.

- Secondary Processing: There may be a need in Colorado's expanded recycling system for facilities that further sort materials into a scrap specification that supports end market needs. These secondary processors may focus on one or more material categories and may not be applicable to all end markets. If secondary processing is needed and applicable to the Program's goals, CAA Colorado's may consider funding to establish secondary processing.

- End Market Development: CAA Colorado is committed to growing end market capacity that consumes covered materials resulting from an expanded recycling system. CAA Colorado prefers that agreements between MRFs and recyclers provide economic incentives for both parties to invest in operations and infrastructure. However, CAA Colorado may need to incentivize downstream markets to accept and use MRL and AML materials in recycling processes. The desired approach would be through an incentive detailed within a contract between CAA Colorado and a recycling market development organization such as the Colorado Circular Communities (C3) enterprise fund or CDPHE's Circular Economy Development Center so that CAA Colorado can leverage external expertise and existing end market investment programs. CAA Colorado may also choose to work with national organizations that span beyond Colorado's borders to further leverage the impact of end market development investments.

- Local End Market Development: As CAA Colorado works to ensure that MRFs have access to REM, there may be greater opportunities for use of PCR in Colorado. If external capital is needed to attract new businesses to Colorado and create a more resilient domestic supply chain, CAA Colorado will coordinate with other recycling market development organizations to best leverage investment impact. CAA Colorado will work closely with recycling market development organizations such as the Colorado Circular Communities (C3) enterprise fund or CDPHE's Circular Economy Development Center to meet with organizations that might be interested in making local developments. CAA Colorado will work closely with

organizations that accept and process covered compostable packaging to identify opportunities to improve end markets for finished compost in Colorado. If it is deemed to be beneficial, system development funds may be utilized to better quantify the value of the product or expand its application.

Other uses may be considered in future years as additional needs are identified.

The Fund will be separate from any special assessment requested by and paid for by producers to improve the collection and recycling of a specific material or facilitate the addition of a material to MRL or AML. The use of this special assessment is further described in the *Operations Plan: Material Strategy* Chapter.

The determination of System Development Fund projects will include criteria that follow CAA Colorado's reimbursement approach principles as described in Section 5.1[47]. To further ensure these principles are met, CAA Colorado will establish an ongoing evaluation process for the System Development Fund. The process will be based on best practices; work undertaken in other jurisdictions; achieving system outcomes that meet program goals; and maintaining a competitive marketplace. CAA will provide an outline of the System Development Fund process, evaluation criteria, and updates on investments, in the annual report.

Role of System Development Fund with Other Types of Recycling Capital

There are existing grants and low-interest financing that are tailored specifically for recycling service providers. CAA Colorado desires to collaborate with these capital sources to help service providers reduce the capital intensity of infrastructure investment and mitigate long-term interest costs. These capital sources also provide expertise that can help Colorado service providers grow the industry within the State. The *Industry-Specific External Capital* Appendix includes a list of some of these funding sources.

14.4 Working with Producers to Reduce the Packaging of Products Using Covered Materials

> **Excerpt from the Act**
> 25-17-709 (4)(v) Describe how the organization will work with and incentivize producers to reduce the packaging of products using covered materials through product design changes, the development of expansion of systems for reusable packaging, and production innovation.

The Act encourages producers to design and manage covered materials to prevent or minimize their negative environmental, social, economic, and health impacts. To help accomplish this goal, CAA Colorado will work with producers to reduce product packaging using covered materials by incentivizing packaging design changes, developing or expanding systems for reusable packaging,

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[47] Stated Principles from Section 5.1: The guiding principles for service provision include fairness, leveraging existing infrastructure and supporting new infrastructure where needed, maintaining a competitive marketplace, driving efficiency, ensuring transparency, and aligning with environmental objectives.

and product innovation. This will be done through four main activities that are briefly described below and further expanded upon in the *Operations Plan: Education and Outreach, Program Budget and Producer Dues,* and *Operations Plan: Reduce, Reuse, and Refill* Chapters:

- Education and outreach activities that highlight the benefits of reuse and refill systems to Coloradans.

- Providing an advantage to reuse and refill covered materials.

- Using eco-modulation to influence packaging design choices and incent product packaging innovation.

- Creating and leading a producer Community of Practice for reuse and refill.

Education and outreach activities that highlight the benefits of reuse and refill system are described in the *Operations Plan: Reduce, Reuse, and Refill* Chapter. CAA Colorado will develop and provide key messaging and customizable templates, an image library, and implementation guidance.

These tools can then be used in collaboration with service providers, local governments, tribal nations, community and other organizations (e.g., trade associations) to deliver relevant messaging. A broad range of approaches to effectively reach target audiences could include websites, apps, social media, print and broadcast media, and collateral (e.g., pamphlets, stickers, calendars, signage).

Incentives to reduce producer dues is one way CAA Colorado will work with producers to reduce product packaging. Reuse and refill materials are financially advantaged as producers are not required to pay producer dues. Additionally, the eco-modulation factors described in the *Program Budget and Producer Dues* Chapter will be used to influence packaging design towards recyclable covered materials. These eco-modulation factors also include a reduction in dues for packaging using reuse and refill designs and awarding high refill rates.

Helping producers reduce product packaging using covered materials may require collaboration with other organizations to communicate producer guidance to provide insights into expanding reuse and refill systems, increase recyclability, and reduce unnecessary packaging. Providing guidance to producers on opportunities and best practices to increase reuse and refill will be conducted through the establishment of a Community of Practice for Reusable and Refillable Packaging. The *Operations Plan: Reduce, Reuse, and Refill* Chapter provides further insights into producer guidance and the Community of Practice.

15 Program Budget and Producer Dues

> **Excerpt from the Act**
> 25-17-705 (4)(m) Include a proposed budget and a description of the process used to determine producer responsibility dues, including a de minimis level in which no dues are charged and an optional flat rate for producers below a certain size to minimize the administrative and reporting costs of the producers and the organization;

15.1 Program Funding Overview

This chapter presents the program budget, the process CAA Colorado will use to set base dues, and the preliminary dues. In accordance with Program requirements, CAA Colorado is presenting a projected five-year program budget. The program budget will be fully funded through the annual producer responsibility dues paid by the producers of covered materials.

CAA Colorado relies on a set of standard guiding principles and methodology to determine how much funding producers are required to contribute to the statewide system. Factors such as net recycling service costs, EPR system costs, material categories, volume of products sold into the state, whether the material is readily recyclable, and commodity revenues must be fairly accounted for when developing fair producer dues.

This chapter describes how the funding approach satisfies statutory requirements to generate sufficient funds to cover the expected Program operating costs as well as the process for de minimis level and flat rate dues.

The projected year one program budget will inform the year one producer dues schedule. CAA Colorado expects the budget and dues ranges to be further refined in 2025 and finalized prior to the October 31, 2025, dues announcement.

15.2 Five-Year Program Budget

The budget was developed based on information from the Needs Assessment and further research including consultations with service providers, state-level data collection, and data from comparable EPR jurisdictions. CAA Colorado will conduct further market studies and engage with local governments and service providers to further refine cost estimates in advance of setting the 2026 producer dues. Interim cost estimates will be updated when better information is available.

In advance of Program's launch, estimates of the Year 1 - 5 Program budget ranges are provided in the tables below. This budget accounts for the recycling system cost reimbursements and other expenses required to achieve the aims of the Act. Program costs will be reviewed and consulted on annually in advance of the producer dues announcement.

Interim Program budget estimates are presented as ranges, given the absence of actual costs and producer supply data, and uncertainty with service reimbursement estimates prior to implementation. As a result, conservative base case and high case scenarios were developed for

the five-year timeframe. For both scenarios, risk-weighted contingencies are applied to high-risk components with more conservative contingencies applied to the high scenario. The differences between the base case and the high case are primarily from the pricing of the variety of recycling services, equipment prices (considering inflation and cost increases), yet-to-be negotiated processing agreements, year-over-year escalators, and operating contingency. These preliminary budget ranges reflect a 12-month program year, and presumes that the Program will launch on January 1, 2026, with approval by CDPHE in the fourth quarter of 2025.

The budget ranges included in this plan are subject to change due to additional inputs and economic factors. Examples of variables that may impact the budgets presented in this plan include recycling service cost data provided by service providers, the date of final plan approval, the uptake of initial service agreements and the time to finalize those agreements. Macro-economic factors such as an inflationary surge, a pandemic, pricing and demand for oil, significant changes in commodity values, worker shortages, and others may also impact the budget in future years. As part of the annual dues-setting process, CAA Colorado will update the budget annually to project the next year's program costs. As required by the Act, any surplus money generated by the program beyond the reserves required for fiscal and prudent management of the program will be placed back into the program for program improvements or a reduction in dues during the next fiscal year. The base case and high case preliminary budgets are presented in Table 30, and a description of each budget category follows.

Table 30: Base and High Case Scenario Program Budgets ($ Millions)

Budget Category	Pre–Program + 2026	2027	2028	2029	2030
Residential – Existing	$121.7 to 160.0	$129.1 to 174.1	$138.7 to 185.9	$144.4 to 193.2	$147.3 to 197.3
Non-Residential – Existing	–	–	$3.7 to 4.5	$4.2 to 5.2	$21.2 to 25.8
System Expansion	$9.7 to 11.6	$35.5 to 41	$61.4 to 75.1	$72.1 to 90.9	$69.6 to 90.3
Compost Funding	$1.5 to 5.0	$1.6 to 5.3	$1.6 to 5.3	$1.6 to 5.3	$1.6 to 5.3
Transfer Facilities and Transportation	$6.0 to 7.2	$6.8 to 8.3	$7.6 to 9.2	$8.4 to 10.2	$9.2 to 11.1
Education and Outreach	$14.0	$15.2	$17.5	$18.2	$20.5
Net Operating Costs	**$152.9 to 197.8**	**$188.2 to 243.9**	**$230.5 to 297.5**	**$248.9 to 323**	**$269.4 to 350.3**
REM and Material Audits	$5.1 to 5.5	$5.9 to 6.5	$6.8 to 7.4	$7.3 to 8.1	$7.7 to 8.5
Regulatory Costs	$1.1	$0.6	$1.4	$0.6	$0.7
Program Start-up	$17.1	–	–	–	–
PRO Management and Admin.	$9.8	$11.0	$9.4	$9.8	$10.3
Program Reserves	$29.0 to 35.7	$28.9 to 31.6	$28.0 to 31.0	$25.7 to 32.4	$6.8 to 20.0
Eco Modulation Fund	–	$4.1 to 5.3	$5.0 to 6.3	$5.4 to 6.9	$5.8 to 7.4
Total Program Budget	**$215.0 to 267.0**	**$238.7 to 298.9**	**$281.1 to 353.0**	**$297.7 to 380.8**	**$300.7 to 397.2**

Description of Budget Category Estimate

The budget is based on existing information and anticipated Program costs, with areas of uncertainty including the reimbursement costs for collection and post-collection processing, service expansion costs, the timing of investments (particularly in rural areas without access to services today), and the impacts of eco-modulation incentives and maluses. Additionally, the costs of CAA Colorado's service approach will depend on the dates of Program approval and service agreement uptake.

Following the first Program year in 2026, CAA Colorado will be able to further refine the budget based on realized reimbursement and Program management costs.

Existing Residential and Non-Residential Costs

These are the estimated net costs of recycling collection and post-collection services of covered materials from residential and non-residential covered entities. These services are in place at Program implementation, and the timing of reimbursement costs follow the approaches described in the *Recycling Services Approach* Chapter. The costs are calculated using the collection and processing reimbursement cost formulas for net recycling services. Estimated commodity revenues are included to offset the recycling costs.

System Expansion Costs

This is the estimated cost of expanding recycling access and service, including collection, drop-off, AML collection, capital upgrades to MRFs and transfer facilities to increase recovery of glass and transition materials from the AML to MRL. The proposed System Development Fund is included in this budget category.

Compost Funding

These costs are for improvements to allow for more efficient processing of compostable packaging and reduction in non-compostable covered material contamination. They are based on the Needs Assessment findings on compost investments, estimated compostable packaging supply, and the potential dues from these producers. The low and high budget estimates are based on estimated annual producer supply of compostable packaging over the five-year budget term.

Transfer Facilities and Transportation

This is the estimated cost of operating existing transfer facilities and the expansion of transfer facilities to accept additional materials. These costs cover the consolidation and transportation of materials from transfer facilities to MRFs.

Education and Outreach

These costs are to deliver the Program's education and outreach plan at the state and the community level as well as the data driven projects, as detailed in the *Education and Outreach* Chapter. This includes reuse, recycling, and compost educational initiatives. The costs of the education and outreach minimum service standards for collectors are included in the net Residential and Non-Residential Costs as they will be included in the reimbursement to participating service providers.

REM and Material Characterization Audits

These costs include program requirements for REM audit and verification activities, material characterization studies, and local end market development costs. REM verification costs are based on the estimated number of Program audits, while REM and local end market development costs were estimated based on the *Operations Plan: Responsible End Markets* Chapter.

Material characterization methodology costs are based on observed costs of auditing programs in other EPR jurisdictions, including costs of characterization studies for inbound and outbound

materials to MRFs as well as the statewide compost characterization study. Costs for service provider-led audits are included in the service reimbursements.

Regulatory Costs

Regulatory costs include the costs for administering, implementing, and enforcing the Program, calculated by, and payable to CDPHE, including the reasonable costs of the Advisory Board and the costs of conducting the future needs assessment. The 2026 regulatory costs are higher than subsequent years as 2026 captures pre-Program costs. The 2028 regulatory costs include the estimated costs of conducting the subsequent needs assessment. Regulatory cost numbers are based on estimates provided by CDPHE.

Program Start-Up

Program start-up costs are those incurred by CAA Colorado for pre-launch Program development and are not considered to be administrative costs. They are one-time time costs and spent over several years before the program was operational. These costs include conducting the initial needs assessment and finalizing the program plan.

PRO Management and Administration

Management and administration costs are CAA Colorado's estimated management and administrative costs necessary for the Program. This includes CAA Colorado office expenses, staffing, overhead, and services support received from Circular Action Alliance's National office. These costs may be up to five percent of the producer dues for administration of the program over the five-year program period.

Program Reserves

CAA Colorado has established program reserves for unforeseen financial risks and to build up working capital based on the projected Program costs. These are intended to cover the most variable and unpredictable elements of Program implementation, namely the recycling services operations and funding requirements, as well as the unanticipated costs that may arise in future years. The reserve strategy has been established to meet the regulatory requirement to fund a financial reserve sufficient to operate the program in a fiscally prudent and responsible manner. The budget includes building a financial reserve with a minimum of three month's operating costs and a maximum of six months. Program reserves are composed of:

- Reserves to cover risks presented by reimbursement, investment, REM, material characterizations, and other operational cost overruns or revenue shortfalls based on the 2029 budget year.

- A financing costs and allowances reserve based on CAA Colorado financial management policies and strategies. The reserves cover variability and risk associated with the collectability of producer dues in the starting years of the program that are outside of CAA Colorado's direct control.

- Additional risk reserves specifically designated for unforeseen expenditure items that may arise due to factors beyond the control of CAA Colorado such as regulatory changes, emergency interventions, or one-time liabilities.

All producers will pay program for reserves through their dues, proportional to their supply weights.

The Act requires CAA Colorado to maintain a financial (operating) reserve sufficient to operate the Program, for between three to six months of operating costs, unless a waiver is sought through CDPHE.

CAA Colorado will build operating reserves over four years with 25 percent built in per year. Any Program surplus (after reaching target levels) shall be considered for either Program reinvestments or as a reduction to producer dues during the next fiscal year. As with all cost items, CAA Colorado will evaluate the reserves annually on the reasonability and amounts associated with the strategy.

Eco-Modulation Fund

The eco-modulation fund is intended to cover eco-modulation bonuses that may not be fully offset by the eco-modulation maluses established by CAA Colorado in the dues-setting process. In 2026, CDPHE will publish additional eco-modulation benchmarks and a bonus schedule that are outside of this program plan. CAA Colorado will begin to pay out the CDPHE designated bonuses to qualified producers beginning in 2027. The bonuses schedule is designated by the CDPHE executive director and is unknown at this time.

Comparison to Needs Assessment and Description of Changes

The Needs Assessment data was based on input from the recycling community, local governments, comparable programs, and subject matter experts. As required by the Act, the Needs Assessment established financial and operating scenarios for a range of recycling rate targets based on Colorado's existing infrastructure and services. CAA Colorado has conducted significant work since the Needs Assessment to further refine and update the potential costs. However, there are Program budget assumptions that remain subject to significant variability (e.g., in year one the program will be initiated based on Program approval).

CAA Colorado conducted further research that resulted in a refinement of the collection and post-collection costs in the budget tables taking into account more information on regional recycling costs, number and types of households served, and commodity values. Inflation was added to reflect future recycling servicing costs and capital. Additionally, contingencies are applied to high-risk drivers previously mentioned, and holistically to the summarized net operating costs.

The Needs Assessment was conducted to meet the requirements of statute. Throughout the Needs Assessment process, CAA received direction on what to include in the assessment from CDPHE and worked closely with the advisory board to ensure alignment. The base and high budgets presented in the Program Plan include cost categories that were not included in the Needs Assessment (as they were not required), such as PRO administration and management, REM development, start-up costs, regulatory costs, and program reserves. The following table

summarizes which categories were or were not included in the Needs Assessment, and which categories were not, and are now in the scope of this budget.

Table 31: Cost Categories Considered in the Needs Assessment

Cost Category	Required to be Covered in the Needs Assessment
Collection and Processing – Residential covered entities	Yes
Collection and Processing – Non–Residential covered entities	Yes
System Expansion – Collection, processing, and depot	Yes
Education and Outreach	Yes
Material Characterization Audits	No
Responsible End Markets	No
Contingency (Cost Escalation/CPI/Inflation)	No
Regulatory Costs	No
Program Development (Start–Up Costs)	No
PRO Management and Admin	No
Program Reserves	No

15.3 Producer Responsibility Dues

Excerpt from the Act

25-17-705 (4)(i) Establish a funding mechanism that: (ii) Is funded through producer responsibility dues. The producer responsibility dues must vary by the type of covered material, whether or not the material is readily recyclable, and be based on the net recycling services costs for each covered material in the state. The organization may use up to five percent of the producer responsibility dues collected from producers for administration of the program, over the terms of the program, in accordance with generally accepted accounting principles, but the organization shall not use any producer responsibility dues collected from producers to pay employee bonuses.

Overview of Producer Dues

Producers are required to pay producer responsibility dues based on the amount and type of covered materials they supply into the state. CAA Colorado will publish an annual schedule detailing base dues, in cents per pound, for each covered material reporting category. These annual updates to dues will reflect changes to the recycling costs, supplied volumes, commodity revenues, and recyclability of each material in the Program, using CAA's harmonized national dues-setting methodology (used in all state EPR programs where Circular Action Alliance has the authority to determine the methodology).

Although this methodology is consistent across states where Circular Action Alliance is the PRO, dues schedules vary between programs to account for factors such as program obligations, supplied volumes, system design, system costs, material scope, and producer definitions.

Guiding Principles for Setting Base Dues

CAA Colorado's dues are established according to the following national dues-setting principles, which have been adapted for Colorado:

- Harmonization: The national dues-setting methodology will be used consistently across states, but dues rates will vary because of differing state requirements and program costs.

- Fairness: Producers must contribute to the costs of the recycling system, including those, that use materials that are not recycled.

- Material-Specific Costs: Dues rates will reflect material-specific management costs in each state using the best available data.

- Commodity Revenue: Dues rates will reflect state-specific commodity revenues, which will be attributed to the corresponding material categories that earned them.

- Eco-Modulation: Dues-setting will account for measurable environmental objectives and state eco-modulation policies. Eco-modulation will be applied after base dues have been calculated.

- Responsible End Markets: Dues-setting will factor in the development and maintenance of viable REM with any associated costs attributed to the material category that requires end market development.

- Clarity: Dues-setting materials and consultations will be prepared and conducted in a manner that clearly communicates to producers the principles, methodologies and approach that CAA is using to determine dues rates.

These principles provide guidance for the development of a fair, transparent and effective dues-setting methodology for producers. Producers of covered materials that are neither collected nor recycled will still incur dues to cover the cost of the recycling system in accordance with the Fairness principle.
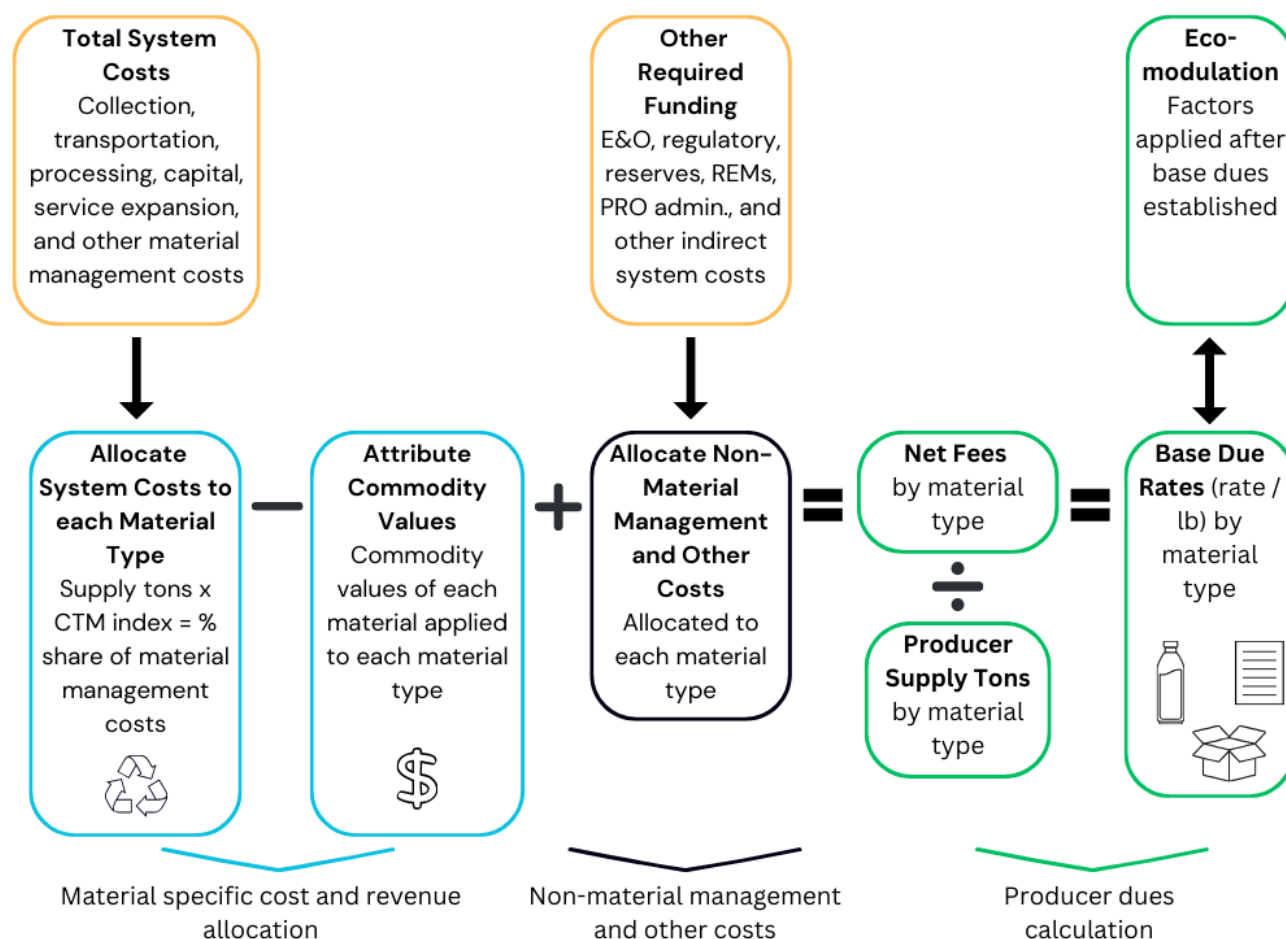
Dues-Setting Process

CAA uses a six-step process to set dues. In step 1, CAA determines total system costs based on its compliance obligations. In step 2, we determine the cost to manage each material category using a state-specific Activity-Based Costing (ABC) model. ABC is a common budgeting method where the administrative and indirect costs are allocated based on specific activities that drive the overall costs. For the recycling system, the model includes estimates of material collected, processed and marketed, cost for curbside and drop-off collection, transfer and hauling costs, and cost to process material in MRFs of different sizes and levels of automation. Step 3, we allocate the total system costs based on the supply tons reported by producers in each material category according to their relative cost to manage. Step 4, we allocate commodity revenues to the material categories that generated the revenue, thus reducing the costs associated with managing these material categories. Step 5, we allocate non-material management costs (e.g., education and outreach, PRO administration, etc.) to each material category. Finally, in step 6, CAA divides the resultant net dues for each material category by the total producer-reported supply tons for that material category

to generate a base due rate. The base dues will be further eco-modulated to calculate the final dues paid by producers of covered materials. The process for eco-modulation is described in the next chapter. In the first program year, the system costs are estimated. In future years, costs will be based on realized system costs. As described, CAA uses a state-specific ABC model to allocate the overall system and program costs in each material category. The model creates Cost to Manage (CTM) indices that represent the cost variations for each material in the recycling system – from collection, to transfer and consolidation, to the costs of sortation in processing facilities. Critical cost drivers that are used to allocate the costs include material volume and density, equipment and labor associated with processing the material and overall space utilization. The model produces individual cost per ton estimates for each material category, that are a weighted average of the costs to collect, haul, process and market the material through each of the channels in the state. For example, this includes costs for rural drop-offs, city contracted collection, open-market collection, transfer and hauling, processing at a MRF and direct haul to an end market. The CTM index is a single value that represents the relative cost to manage each material. For instance, the CTM index for paper categories are relatively low, because the cost per ton to collect, process and market paper is relatively low.

CAA will consult with the producer community on the dues-setting methodology. Notification of dues webinars will be emailed to all registered producers and posted to the CAA website. During each session, CAA will present the annual dues schedule, any changes, and allow for questions and feedback from the producer community. Follow-up emails will be sent to all webinar attendees detailing the topics discussed, questions answered, and input gathered, as well as next steps and follow-up webinars.

Figure 8 below presents an overview of the dues-setting process, with each step further described below. Each material will have different cost impacts based on their quantities, material properties, and relative ease of collection and recycling in Colorado.

Figure 8: Producer Dues–Setting Process

Material specific cost and revenue allocation   Non-material management and other costs   Producer dues calculation

Material Specific Cost and Revenue Allocation

The total system costs of direct material management such as collection, transfer, transportation, and processing are calculated annually. The costs are allocated to each material category using producer–reported supply weights and the CTM index, as described in the previous section. This ensures dues accurately reflect the varying impacts materials have on the recycling system.

Revenues from recycled materials, either positive or negative, are then attributed to the corresponding material categories, impacting their share of management costs. Materials generating high revenues may offset their dues or even result in incentives for producers, encouraging the use of materials with robust REM.

Non–Material Management and Other Costs

Indirect costs (other required funding) such as Program administration and management, education and outreach, REM development, and regulatory costs are allocated separately from material–management costs. The indirect costs of other required funding are allocated to each material based on supplied tons. Additionally, costs from other material–specific programs or

initiatives are assigned directly to relevant materials. This would also apply to any special assessment requested and paid for by producers of a specific material to improve the collection and recycling of that material or facilitate its addition to MRL. The application of this special assessment is described in the *Operations Plan: Material Strategy* Chapter.

Producer Dues Calculation

Producer dues are calculated using the following components:

- Base Dues Rates: Determined by dividing net costs (allocated material management costs minus revenues plus a portion of non-material management costs and program reserves) by all producer-reported supply weights for each material.

- Supply Weights: Producers report the weight of materials they supply annually.

Eco-modulation adjustments align with environmental goals and may impact a producer's dues based on factors like material design, recyclability, and environmental impact. Incentives or maluses are applied to base dues to reward producers for environmentally friendly practices or penalize inaction. Eco-modulation is further described in the following chapter.

Compostable Packaging and Products Dues Calculation

The dues for covered compostable packaging are calculated differently from other covered materials as it has different requirements in the legislation. Unlike recyclable covered materials, the Act does not require the PRO to reimburse the costs of service (collection and processing) for composting covered packaging.

As a result, CAA Colorado's current dues-setting methodology for compostable packaging does not assign material management costs to this type of packaging. Most of the costs associated with compostable packaging are derived from the budgeted direct costs of targeted investments in compost funding. This funding is designed to encourage composting sites to accept and improve recovery of these materials. Like other covered materials, compostable materials are allocated a portion of these direct costs based on supplied weights. Additionally, the indirect costs (other required funding for program operations related to compostable packaging such as education and outreach and PRO administration) are allocated to covered compostables to ensure that all covered materials contribute proportionally to system costs.

Timing of Producer Dues-Setting

Producers are required to report covered material supply quantities annually to CAA Colorado, and correspondingly, CAA Colorado will announce dues rates annually. Producers will report calendar year 2024's paper and packaging supply on or before July 31, 2025. This will be used to calculate 2026 dues, which will be announced by October 31, 2025. Beginning in 2026, producers will report the previous year's supply in May, which will be used to publish dues for the following year in the Fall. The following Calendar details producer reporting deadlines and CAA Colorado due rate announcements to 2030.

Table 32: Producer Reporting and Dues Calendar

Reporting or Announcement Date (on or before)	Dues Milestone
July 31, 2025	Producers report full year 2024 supply data.
October 31, 2025	CAA Colorado announces Colorado dues rates for 2026.
January 2026	Producers begin paying their dues.
May 31, 2026	Producers report 2025 Colorado supply.
October 1, 2026	CAA Colorado announces Colorado dues rates for 2027.
May 31, 2027	Producers report 2026 Colorado supply.
October 1, 2027	CAA Colorado announces Colorado dues rates for 2028.
May 31, 2028	Producers report 2027 Colorado supply.
October 1, 2028	CAA Colorado announces Colorado dues rates for 2029.
May 31, 2029	Producers report 2028 Colorado supply.
October 1, 2029	CAA Colorado announces Colorado dues rates for 2030.
May 31, 2030	Producers report 2029 Colorado supply.

15.4 Reporting Categories for the Dues-Setting

CAA Colorado proposes 61 material reporting categories for producer reporting, as shown in the table below, which will be used to establish dues rates. This list is based on CAA Colorado's understanding of the Act's requirements, and guidance from the Advisory Board and CDPHE. Producer reporting alignment with California and Oregon's EPR programs were considered to enable producer reporting harmonization.

Table 33: Covered Materials Reporting Categories

Material Class	Reporting Category	Status
Paper Products	Newspapers	Minimum Recyclables List
	Newsprint (inserts and circulars)	Minimum Recyclables List
	Magazines and Catalogs & Directories	Minimum Recyclables List
	Paper for General Use	Minimum Recyclables List
	Other Printed Materials	Minimum Recyclables List
Glass and Ceramics	Glass Bottles & Jars and Other Containers	Minimum Recyclables List
	Ceramic – All Forms	Not Collected
Metal	Aluminum Containers	Minimum Recyclables List
	Aluminum Foil and Molded Containers	Additional Materials List
	Aluminum Aerosol Containers	Minimum Recyclables List
	Aluminum – Other Forms	Additional Materials List
	Steel Containers	Minimum Recyclables List
	Steel Aerosol Containers	Minimum Recyclables List
	Steel – Other Forms	Additional Materials List
	Metal – Small Format	Minimum Recyclables List
	Pressurized Cylinders	Not Collected
Paper/Fiber	Aseptic and Gable-top Cartons	Minimum Recyclables List
	Kraft Paper	Minimum Recyclables List
	Corrugated Cardboard	Minimum Recyclables List
	Waxed Corrugated Cardboard	Not Collected
	Paperboard	Minimum Recyclables List
	Polycoated Paperboard	Additional Materials List
	Other Paper Laminates	Additional Materials List
	Other Paper Packaging – Molded Pulp Food Serviceware	Additional Materials List

	Other Paper Packaging	Minimum Recyclables List
	Paper – Small Format	Additional Materials List
Plastic–Rigid	PET (#1) – Bottles, Jugs, and Jars (Clear/Natural)	Minimum Recyclables List
	PET (#1) – Bottles, Jugs, and Jars (Pigmented/Color)	Additional Materials List
	PET (#1) – Other Rigid Containers, Cups, Lids, Plates, Trays, Tubs (Clear/Natural)	Minimum Recyclables List
	PET (#1) – Other Rigid Containers, Cups, Lids, Plates, Trays, Tubs (Pigmented/Color)	Additional Materials List
	PET (#1) – Other Rigid Items	Additional Materials List
	HDPE (#2) – Bottles, Jugs and Jars (Clear/Natural)	Minimum Recyclables List
	HDPE (#2) – Bottles, Jugs and Jars (Pigmented/Color)	Minimum Recyclables List
	HDPE (#2) – Pails & Buckets	Minimum Recyclables List
	HDPE (#2) – Tubs	Minimum Recyclables List
	HDPE (#2) – Nursery (plant) Pots and Trays	Additional Materials List
	HDPE (#2) – Squeeze Tubes	Additional Materials List
	HDPE (#2) – Other Rigid Items	Minimum Recyclables List
	PVC (#3) – Rigid Items	Not Collected
	LDPE (#4) – Bottles, Jugs and Jars	Additional Materials List
	LDPE (#4) – Other Rigid Items	Additional Materials List
	PP (#5) – Bottles, Jugs and Jars	Minimum Recyclables List
	PP (#5) – Containers, Cups, Lids, Plates, Trays, Tubs	Minimum Recyclables List
	PP (#5) – Nursery (plant) Pots & Trays	Additional Materials List
	PP (#5) – Squeeze Tubes	Additional Materials List
	PP (#5) – Other Rigid Items	Minimum Recyclables List

	PS (#6) – Expanded/Foamed Hinged Containers, Plates, Cups, Tubs, Trays, and Other Foamed Containers	Not Collected
	PS (#6) – White Expanded/Foamed Cushioning	Additional Materials List
	PS (#6) – Colored Expanded/Foamed Cushioning	Not Collected
	PS (#6) – Rigid Non-Expanded	Not Collected
	Other/Mixed Rigid Plastic	Not Collected
Plastic-Flexible	HDPE (#2)/LDPE (#4) – Flexible and Film Items	Additional Materials List
	PP (#5) – Flexible and Film Items	Not Collected
	Plastic Laminates and Other Flexible Plastic Packaging	Not Collected
Plastic-Other	Plastic – Small Format	Not Collected
	Plastic Packaging – Hazardous or Special Products	Not Collected
Wood and Other Organics	Wood and Other Organic Materials	Not Collected
Certified Compostable Packaging and Food Serviceware	Paper – Certified to ASTM D8410-22	Not Collected
	Plastic and Polymer Coated Substrates – Certified to ASTM D6868-21	Not Collected
	Rigid Plastic – Certified to ASTM D6400-23	Not Collected
	Flexible Plastic – Certified to ASTM D6400-23	Not Collected

15.5 Base Dues Ranges (Simplified Schedule)

Excerpt from the Act

25-17-705 (4)(i) Establish a funding mechanism that: (I) Does not exceed the direct and indirect costs of implementing the program, including the costs of: (A) Providing recycling services under the program through contracts with service providers or reimbursement of recycling services costs under the reimbursement rates proposed pursuant to subsection (4)(j) of this section; (B) Meeting the reporting requirements set forth in section 25-17-709 (2); (C) Conducting the needs assessment; (D) Developing and updating the final plan; (E) Implementing the education and outreach program set forth in section 25-17-707; (F) Reimbursing the department pursuant to section 25-17-715 for its costs in administering and implementing this part 7, including the costs of the advisory board; and (G) Reimbursing the department pursuant to section 25-17-715 for the costs of enforcing this part 7 pursuant to section 25-17-710;

Table 34 presents the initial aggregated base dues for multiple material reporting categories, the range of base dues, and the dues after applying the eco-modulation Approach 1 factors. The eco-modulation factors and approaches are described in detail in the *Eco-Modulation Approach* Chapter.

For example, the table shows that Plastic Rigid – PET materials on MRL dues range from a low of 15.6 cents per pound, to a high of 17.0 cents per pound, depending on the individual Rigid PET material category. The average of the aggregated dues for Plastic Rigid – PET materials on MRL is 15.9 cents per pound. When the eco-modulation factors are included, the average aggregated dues for Plastic Rigid – PET materials on MRL is 15.4 cents.

The final dues schedule for the upcoming program year will be published in the fourth quarter of the current year (e.g. final dues for 2026 are published in the fourth quarter of 2025) after producers complete their supply reporting. CAA Colorado will publish the dues schedule in CAA's producer portal and submit the final dues schedule to CDPHE, after notifying registered producers. CAA Colorado's annual report will include the total amount of producer responsibility dues collected under the Program, an annual schedule of those dues assessed by weight for each type of covered material, any annual increases or decreases in the dues schedule weight for each type of covered material, any annual increases or decreases in the dues schedule and the reasons.

Table 34: Illustrative Base Dues and Base Dues with Eco–Modulation Approach 1, By Aggregated Material Category

Material Category Aggregation	Covered Material List	Range Minimum Base Dues	Average Base Dues	Range Maximum Base Dues	Average Base Dues + Eco–Modulation
Paper Products	MRL	6.0 ¢/lb	**6.0 ¢/lb**	6.0 ¢/lb	**6.0 ¢/lb**
Glass	MRL	4.2 ¢/lb	**4.2 ¢/lb**	4.2 ¢/lb	**4.0 ¢/lb**
Ceramics	NC	44.8 ¢/lb	**44.8 ¢/lb**	44.8 ¢/lb	**47.0 ¢/lb**
Aluminum Containers	MRL	2.1 ¢/lb	**2.1 ¢/lb**	2.1 ¢/lb	**2.0 ¢/lb**
Aluminum – Other	MRL	14.0 ¢/lb	**14.0 ¢/lb**	14.0 ¢/lb	**14.0 ¢/lb**
Aluminum – Other	AML	33.0 ¢/lb	**33.8 ¢/lb**	34.0 ¢/lb	**33.8 ¢/lb**
Steel Containers	MRL	7.3 ¢/lb	**7.3 ¢/lb**	7.3 ¢/lb	**7.0 ¢/lb**
Steel /Metal – Other	MRL	14.0 ¢/lb	**19.9 ¢/lb**	32.0 ¢/lb	**19.9 ¢/lb**
Steel /Metal – Other	AML	34.0 ¢/lb	**34.0 ¢/lb**	34.0 ¢/lb	**34.0 ¢/lb**
Steel /Metal – Other	NC	19.1 ¢/lb	**19.1 ¢/lb**	19.1 ¢/lb	**37.0 ¢/lb**
Paper/Fiber Packaging	MRL	8.0 ¢/lb	**8.8 ¢/lb**	13.0 ¢/lb	**8.6 ¢/lb**
Paper/Fiber Packaging	AML	20.0 ¢/lb	**23.2 ¢/lb**	30.0 ¢/lb	**23.2 ¢/lb**
Paper/Fiber Packaging	NC	17.3 ¢/lb	**17.3 ¢/lb**	17.3 ¢/lb	**25.0 ¢/lb**
Plastic – Rigid PET	MRL	15.6 ¢/lb	**15.9 ¢/lb**	17.0 ¢/lb	**15.4 ¢/lb**
Plastic – Rigid PET	AML	41.3 ¢/lb	**43.7 ¢/lb**	48.0 ¢/lb	**45.5 ¢/lb**
Plastic – Rigid HDPE	MRL	14.6 ¢/lb	**20.9 ¢/lb**	31.0 ¢/lb	**20.2 ¢/lb**
Plastic – Rigid HDPE	AML	71.0 ¢/lb	**71.0 ¢/lb**	79.0 ¢/lb	**71.0 ¢/lb**
Plastic – Rigid Other	AML	50.0 ¢/lb	**117.2 ¢/lb**	156.0 ¢/lb	**117.2 ¢/lb**

Plastic – Rigid Other	NC	77.8 ¢/lb	**98.2 ¢/lb**	160.2 ¢/lb	**101.2 ¢/lb**
Plastic – Rigid PP	MRL	20.0 ¢/lb	**20.9 ¢/lb**	25.0 ¢/lb	**20.9 ¢/lb**
Plastic – Rigid PP	AML	73.0 ¢/lb	**77.2 ¢/lb**	79.0 ¢/lb	**77.2 ¢/lb**
Plastic – Flexible	AML	48.0 ¢/lb	**48.0 ¢/lb**	48.0 ¢/lb	**48.0 ¢/lb**
Plastic – Flexible	NC	64.0 ¢/lb	**69.8 ¢/lb**	71.1 ¢/lb	**72.2 ¢/lb**
Plastic – Other	NC	49.9 ¢/lb	**50.0 ¢/lb**	50.0 ¢/lb	**52.0 ¢/lb**
Wood and Other Organics	NC	80.7 ¢/lb	**80.7 ¢/lb**	80.7 ¢/lb	**84.0 ¢/lb**
Certified Compostable Packaging and Food Service Ware	NC	25.1 ¢/lb	**28.4 ¢/lb**	32.0 ¢/lb	**29.2 ¢/lb**

De Minimis Level and Initial Flat Dues

Excerpt from the Act

25-17-705 (4)(m), include a proposed budget and a description of the process used to determine producer responsibility dues, including a de minimis level in which no dues are charged and an optional flat rate for producers below a certain size to minimize the administrative and reporting costs of the producers and the organization.

CAA Colorado will use the de minimis level (in which no dues are charged) for small producers established in the legislation which is based on global producer revenue and supply into Colorado.

CAA Colorado will offer an optional flat rate for low volume producers to minimize the administrative and reporting costs. The flat rate will be graduated based on the producer's supplied tons into the Colorado and will not vary by material category(ies) supplied into the state. Producers who supply ten tons or less of covered materials into the state are eligible to pay flat dues. The table below includes flat dues categories and the ranges of interim flat dues rates. The final flat dues will be published in the fall of 2025, following the initial supply data submission and a more complete understanding of the number of producers that may qualify for flat dues. CAA Colorado may adjust the flat dues categories based on the supplied data to accurately reflect Colorado's producer marketplace.

Table 35: Initial Flat Dues

Category (Supplied Tons)	Estimated Dues Ranges
1.0 to 2.5 tons	$600 to $800
2.51 to 5 tons	$1,300 to $1,800
5.01 to 7.5 tons	$2,100 to $2,900
7.51 to 10.0 tons	$2,900 to $4,000

Publisher In-Kind in Lieu of Paying Dues (Print and Online Advertising)

> **Excerpt from the Act**
> 25-17-705 (4)(h) describe how the organization will work with newspaper publishers and magazine and periodical publishers to accept print or online advertising in lieu of all or a portion of the producer responsibility dues for newspapers, magazines, and periodicals circulated within the state.

CAA Colorado shall accept the value of print and online advertising services in lieu of all or a portion of dues payable by newspaper, magazine, or periodical publishers that are primarily focused on Colorado and offer a reasonable opportunity for CAA to educate Colorado residents or non-residential covered entities on the Program. These producers must register and submit data to CAA Colorado. Producers must indicate intent to participate in the in-kind program. Once the dues are determined, CAA Colorado will collaborate with participating producers to design a tailored approach for media content strategy that aligns with CAA Colorado's education and outreach goals.

CAA Colorado will further establish a policy for publisher in-kind in lieu of paying dues in consultation with CDPHE, which will reflect the following principles:

- There should be a connection between what is on offer from publisher-producers and what CAA Colorado would otherwise choose.

- The media and in-kind content opportunities on offer from participating producers must represent fair market value equal to what CAA Colorado could obtain on the open market for similar services.

- Advertising and in-kind opportunities must deliver critical mass statewide, or within a defined and generally accepted intra-State advertising market.

- Opportunities must fit reasonably into CAA Colorado's statewide education and outreach plan.

- The in-kind privilege should be "paid" in the form of credits against the producer's account, not as part of the dues-setting process. Following the execution of the media campaign, the

producer may apply for credit by submitting verification of in-kind advertisements. Any remaining balance after credits are applied will need to be paid in full.

- There should be a connection between advertising and content offerings from publisher-producers and CAA Colorado's education and outreach plan requirements.

- The advertising and content opportunities offered by participating producers must represent fair market value, equal to what CAA Colorado would pay on the open market for similar services.

- Advertising and content opportunities must reach a minimum number of households/consumers across Colorado, or within a defined and generally accepted intra-State advertising market.

- Advertising and content opportunities must fit reasonably into CAA Colorado's education and outreach plan.

The in-kind privilege should be paid in the form of credits against the producer's account, not as part of the dues-setting process. Following the publishing of the in-kind advertising or content, the producer may apply for credit by submitting verification of in-kind advertisement or content. Any remaining balance after credits are applied will need to be paid in full.

Offsetting Producer Dues for Programs

> **Excerpt from the Act**
> 25-17-705 (t) Describe how the organization will reduce or offset the producer responsibility dues for any producer or group of producers that fund or operate a collection program that: (I) covers a specific type of covered material that is not processed by materials recovery facilities; and (II) has recycling rates that meet or exceed the minimum recycling rate target set forth in the plan proposal pursuant to section (4)(p) of this section.

After the first year of Program operation, CAA Colorado will implement an application process that would reduce or offset the producer responsibility dues for any producer or group of producers that fund or operate a collection program that:

- Covers a specific type of covered material that is not processed by MRFs.

- Has recycling rates that meet or exceed the minimum recycling rate target set forth in this Program.

This would include covered materials that are not on the minimum recyclables list and not processed commingled at MRFs. CAA Colorado will provide guidance on the application process, but producers would at a minimum need to describe the collection program, its scope, geographic boundaries, funding mechanism, history and performance indicators, including verifiable recycling rates and REM. SKU level reporting may be required. CAA Colorado may consider limitations on dues reductions to ensure budget stability.

16 Eco-Modulation Approach

> **Excerpt from the Act**
>
> CRS 25-17-705 (i) establish a funding mechanism that: (II) is funded through producer responsibility dues. The producer responsibility dues must vary by the type of covered material, whether or not the material is readily recyclable, and be based on the net recycling services costs for each covered material in the state.
>
> CRS 25-17-705 (i) establish a funding mechanism that: (IV) Includes eco-modulation factors that lower producer responsibility dues to incentivize: (A) reductions in the amount of packaging materials used for products; (B) innovations and practices to enhance the recyclability or commodity value of covered materials; (C) high levels of postconsumer recycled material use; (D) designs for the reuse and refill of covered materials; and (E) high recycling and refill rates of covered materials;
>
> CRS 25-17-705 (i) establish a funding mechanism that: (V) Includes eco-modulation factors that increase producer responsibility dues to discourage: (A) designs and practices that increase the costs of recycling, reusing, or composting covered materials; (B) designs and practices that disrupt the recycling of other materials; and (C) producers from using covered materials that are not on the minimum recyclable list.

16.1 Eco-Modulation Approach

Eco-modulation factors, in the form of incentives and maluses outlined in the table below, will be used to adjust producer base dues with the aim of influencing producer product or packaging design choices. Eco-modulation will be applied after the base dues have been calculated. As additional producer and recycling system data is gathered, eco-modulation benchmarks and factors will be evaluated annually by CAA Colorado and may be adjusted to further incentivize or discourage producer product or packaging design choices.

Table 36: Required Eco-Modulation Incentives and Maluses

Incentives (decrease dues)	Maluses (increase dues)
a. Reductions in the amount of packaging materials used for products b. Innovations and practices to enhance the recyclability or commodity value of covered materials c. High levels of PCR material use d. Designs for the reuse and refill of covered materials e. High recycling and refill rates of covered materials	a. Designs and practices that increase the costs of recycling, reusing, or composting covered materials b. Designs and practices that disrupt the recycling of other materials c. For producers using covered materials that are not on the minimum recycling list

At the beginning of the Program, CAA Colorado will use two approaches to apply the eco-modulated dues concurrently, depending on the targeted producer packaging or design choice.

Table 37: Eco-Modulation Incentives and Maluses by Approach

Approach 1	Approach 2
Incentives e. High recycling and refill rates of covered materials **Maluses** a. Designs and practices that increase the costs of recycling, reusing, or composting covered materials b. Designs and practices that disrupt the recycling of other materials c. For producers using covered materials that are not on the minimum recycling list	**Incentives** a. Reductions in the amount of packaging materials used for products b. Innovations and practices to enhance the recyclability or commodity value of covered materials c. High levels of PCR material use d. Designs for the reuse and refill of covered materials e. High recycling and refill rates of covered materials

Approach 1 – For Incentive e. and Maluses a., b., and c.

CAA Colorado will build on the findings of the Needs Assessment (see Element 8) to implement eco-modulation for four of the eight targeted producer practices described in the Act. This covered material evaluation utilized four scoring criteria to objectively evaluate materials and has been reviewed thoroughly as part of the Needs Assessment approval process.

Eco-modulation factors are applied uniformly across a specific material reporting category after base dues have been calculated and will either increase or decrease dues for that reporting

category. Individual producers will be responsible for paying the eco-modulated dues. The factors will be set on a per-pound basis or as a percentage of payable base dues and will be applied beginning on the first year of dues.

Malus a. and b. will be addressed through a single eco-modulation factor (i.e., the detriments scoring category[48] applied in the Needs Assessment) used to discourage both designs and practices that increase the costs of recycling, reusing, or composting covered materials and disrupt the recycling of other materials. These two maluses are similar; often practices or designs that increase costs also disrupt the recycling of other materials (e.g., a small format package can increase the cost to recycle that material while disrupting the recycling of other materials). While these will be dealt with together at the beginning of the Program, this will be re-evaluated on an annual basis.

The table below outlines the proposed eco-modulation factors, the targeted activities and practices that will be adjusted through the findings of the Needs Assessment material evaluation approach, and the relevant Needs Assessment criteria.

Table 38: Origin of Each Eco-Modulation Factor

Eco-Modulation Factor	Targeted Activities	Needs Assessment Scoring Criteria
Recycling rates (sortability)	High recycling rates of covered materials (incentive e.)	Criteria 2: Sorting. Criteria Relevance: Evaluation of packaging characteristics that can impact how effectively the material can be sorted and separated into an individual end market commodity based on Colorado's current infrastructure

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[48] The Needs Assessment evaluated whether the material impacted the quality of the recycling system on the recycling commodity stream.

Detriments	• Designs and practices that increase the costs of recycling, reusing[49], or composting covered materials (malus a.) • Designs and practices that disrupt the recycling of other materials (malus b.)	Criteria 4: Detriments. Criteria Relevance: Certain material characteristics may create health and safety issues during collection and sorting processes, create contamination issues that reduce end market opportunities, or be considered prohibitive for final commodity outputs. Note that these detriments only related to the packaging, not the contents. (malus b. only)
Materials not on MRL	Discourage producers from using covered materials that are not on the minimum recyclable list (malus c.)	Combined Criteria 1 through 4 Criteria Relevance: A combined single score was given for each material evaluated in the Needs Assessment. Based on the total score, materials were placed on MRL, AML, or the not collected list. A score of 4–6 is a near-perfect score, and materials with this score were included in the proposed MRL. Next, materials with a score of 7–10 were included in the proposed AML. Finally, materials with a score of 11–16 were included on the not collected list.

CAA Colorado will undertake the following steps to establish each eco-modulation factor:

1. Utilize the Needs Assessment scoring criteria for covered materials (Needs Assessment Element 8. Minimum Recyclables List) as the starting point for the material category evaluation (see Table 7 in Element 8 of the Need Assessment). CAA Colorado will utilize the scoring criteria related most closely to the eco-modulation incentive or malus within a material category (presented in the table above).

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[49] The designs and practices that increase the costs of reuse/refill will be captured by a proxy approach related to the end-of-life management of the packaging. In other words, the recyclability of the reusable/refillable packaging will be used initially as a proxy for the entire cost, which will not be available at the start of the Program. As at home reusable/refillable packaging is a covered material, this will already be captured under the covered materials reporting categories and the above maluses also apply – so, essentially, if the reusable/refillable packaging is less recyclable than it would be in a covered material reporting category with a higher due and potentially a malus, therefore increasing the cost as required by the Act.

2. In 2025, establish and lead an eco-modulation technical committee consisting of non-producer independent industry experts.

   - The primary objectives of the committee would be to provide annual recommendations to ensure the factors are applied consistently, recommend updates or new scoring for materials reporting categories, and advise CAA Colorado on considerations related to how eco-modulation is applied, including the level of any eco-modulation factor.

   - The technical committee could include expertise in: MRFs, sorting, end markets, commodities, packaging design, EPR programs, third-party recyclability assessment schemes, compostables, reuse/refill, and other subjects as needed.

   - CAA Colorado will consider industry design guidelines from the Recycled Materials Association, APR, American Forest and Paper Association, Can Manufacturers Institute, Carton Council, Poly Coated Paper Alliance and other industry groups.

   - Information updates will be provided to the Advisory Board on the work being undertaken by the technical committee.

3. CAA Colorado will assess recommendations of the technical advisory committee in developing and publishing the eco-modulation guidance.

4. For both the incentives and maluses, guidance will be developed and published in October 2025 to accompany the publication of the 2026 dues rates. The guidance will include final eco-modulation factors and impacts on material category dues. The rates will be based on producer-supplied data that will be submitted to CAA Colorado in July 2025. For the first program year, the malus will increase base dues, excluding reserves, by five percent for the applicable material category. The incentive will decrease base dues, excluding reserves, by five percent for the applicable material category. CAA Colorado will submit the final eco-modulation rates and guidance to CDPHE and will publish the guidance on CAA's producer portal, after notifying registered producers.

Eco-Modulation for Materials Not on MRL

CAA Colorado will apply the eco-modulation factor to materials not on MRL (malus c), in the following way:

1. The malus for producers using covered materials not on the minimum recycling list will be applied starting in the first Program year. The list of materials on MRL, AML, and non-collected covered materials is included in the *Operations Plan: Material Strategy* Chapter.

2. The factor is applied after the base dues have been calculated and the eco-modulation maluses (malus a and b) have already been applied.

3. The factor will be applied in two tiers:

- Adjust dues for any covered materials not on MRL to ensure they are higher than the calculated average for similar covered materials on MRL. For example, the dues for a rigid plastic material not on MRL will be compared to average of rigid plastic materials included on MRL, and eco-modulated to ensure the dues are higher for the non-MRL material. For the first program year, the malus will ensure that AML materials dues are at least 20 percent higher than the average of dues for similar materials on the MRL.

- Adjust dues for any covered materials not on MRL or AML to ensure they are higher than the calculated average for similar covered materials that are on the AML. For the first program year, the malus will ensure that not collected materials dues are at least 10 percent higher than the average of dues for similar materials on the AML.

As above, guidance will be written and published in October 2025 that would accompany the publication of the 2026 dues rates.

Continuous Improvement

The eco-modulation approach will be refined and improved over time. For example, once data is obtained on recycling rates of each covered material category (from supplied data and data on recycled quantities from MRF audits), this data would replace the approach for incentive e. Beginning in 2027, CAA Colorado will evaluate the 2026 data to determine if actual recycling rate data can accurately be applied to each covered materials reporting category.

Approach 2 – For Incentives a., b., c., d. and e. (Refill Rates)

At Program onset, eco-modulation factors for four of eight of identified targeted activities from the Act cannot be applied at a material category level, as they are specific to individual producer practices and not material reporting categories. The incentives will be granted via a verification process in which eligible producers submit additional reporting data to substantiate their claims about the stated performance of their selected packaging and to minimize fraudulent claims. Data will be submitted through the producer portal.

To further establish the benchmarks for individual producer-based eco-modulation factors, CAA Colorado will undertake the following:

1. Seek feedback from the eco-modulation technical advisory committee to help CAA Colorado establish the thresholds (e.g., 90 percent plus PCR in targeted material class X is eligible for a bonus) for 2026.

2. After assessing that feedback, CAA Colorado will publish guidance in October 2025 accompanying the publication of the 2026 dues schedule.

The proposed eco-modulation factors, addressed through the individual producer approach, would include the following, as set out in the table below.

Table 39: Eco-Modulation Factors

Eco-Modulation Factor	Targeted Activities	Details
Reduction	Reductions in the amount of packaging materials used for products (incentive a.)	• The objective is to primarily target materials where the incentive is most needed to reduce excessive packaging. • The bonus may be based on one of the following factors: number of components, product/ package ratio, or average unit weight. • Verification requires proof of source reduction for SKUs that are above a minimum or threshold level of source reduction
PCR	High levels of postconsumer recycled material use (incentive c.)	• Weight based or threshold percent of PCR content for materials, SKUs or components of SKUs. Verification will require proof of PCR use through chain of custody or other verified reporting mechanisms. • PCR criteria will vary by material class (i.e., paper, glass, metal, rigid plastic, flexible plastic)
Innovation and Enhancement	Innovations and practices to enhance the recyclability or commodity value of covered materials (incentive b.)	• Documentation of the change or innovation and the impact on either increased recovery at MRFs or recognition of new commodity value or bale acceptance • Change must meet or exceed threshold guidance
Reuse and refill	Designs for the reuse and refill of covered materials (incentive d.) High refill rates of covered materials (incentive e.)	• Verification through submission of detailed documentation of established reuse/refill schemes or system investment. • Threshold rates used as verification; for example, ratio between main product and quantities of refills sold on the market as assumed refill rate or other data provided through the case study. • The incentive will be granted based on at home reusable or refillable packaging considered covered materials.

The following relate to all individual producer bonus factors:

- Producers will receive a reduction in cents per pound or a percentage reduction from base dues for the qualifying material, SKUs and/or its covered material components.

- Bonus is limited to producers of covered materials that are paying dues, meaning that producers of non-covered reusable and refillable packaging materials that do not pay dues will not receive any bonus payments.

- Producers will need to provide additional data to substantiate claims and the applicable covered material must be supplied in Colorado.

After a full Program year, CAA Colorado will obtain producer supply data to evaluate additional approaches to refining eco-modulation factors. For the first program year, the incentives will be a five percent reduction in base dues, excluding reserves, for applicable materials.

Timeline

2025:

- Eco-Modulation Technical Committee established to provide recommendations to CAA Colorado by September 2025.

- CAA Colorado publishes dues and eco-modulation guidance in October 2025. Dues will incorporate material category eco-modulation factors and the dues adjustment factor for materials not on MRL nor the AML (Approach 1).

- CAA Colorado to publish guidance for eco-modulation data submission requirements and verification processes for additional producer-level incentives (Approach 2).

- CAA Colorado will submit the final eco-modulation rates and guidance to CDPHE and will publish the guidance on CAA's producer portal, after notifying registered producers.

2026:

- Producer dues include eco-modulation.

- Producers submit voluntary data required for incentive verification (Source reduction, PCR, reuse and refill, innovation and enhancement).

- CAA Colorado reviews and verifies submitted eco-modulation incentive data.

- CAA Colorado to publish updated eco-modulation guidance and factors, considering CDPHE bonuses and benchmarks, along with 2027 dues.

2027:

- CAA Colorado applies remaining eco-modulation incentives granted in 2026 to 2027 dues for verified producers. With support from the technical committee, CAA Colorado evaluates 2026 data to further refine eco-modulation approach, benchmarks, and factors.

17 CAA Colorado Management and Compliance

This chapter describes plans for day-to-day management of the Program, communications, data gathering, reporting processes, producer compliance, and related policies and procedures.

CAA Colorado is committed to upholding the highest standards of ethics, integrity, and compliance with all relevant local, state, and federal laws and regulations to ensure the trust and confidence of CDPHE, producers, collaborators, employees, service providers, local governments, and the state of Colorado.

17.1 Overall Day-to-Day Management

CAA Colorado will provide management of the Program's overall day-to-day operations, finance and administration utilizing qualified personnel dedicated to the Colorado Program. Circular Action Alliance's national team will lead producer services and provide business support, while collaboration across Circular Action Alliance ensures all programs are functioning in the most consistent, effective and efficient manner.

The following resources will be the main points of contact and responsible for Program compliance:

Primary Contact	Secondary Contact
Name: Juri Freeman	Name: Shane Buckingham
Position: Executive Director	Position: Chief of Staff
Phone: (833) 424-7285	Phone: (833) 424-7285
Email: coloradoinfo@circularaction.org	Email: info@circularaction.org

CAA Colorado Plans for General Communication and Coordination

CAA Colorado understands that effective collaboration and communication with all groups in Colorado's recycling system is critical to CAA Colorado successfully meeting its obligations and delivering recycling system improvements.

CAA Colorado proposes several coordination and communication activities and notes that the frequency of each activity will, by necessity, evolve to reflect the Program's needs. A set cadence for each activity will be determined that is agreeable to the targeted audience and reflects the Program's ongoing needs.

General Communications

CAA Colorado's website features a professionally designed and maintained section dedicated to Colorado and can be found at www.circularactionalliance.org. This online resource is currently geared toward potential producers but will be expanded to target additional audiences, including sections tailored to the public, service providers, local governments, and others.

CAA Colorado expects to use other communication tools as demand for information is established, the communication tools will vary in both format and frequency.

Colorado Department of Public Health and Environment

CAA Colorado has established on-going meetings between its representatives and CDPHE. These meetings build on the strong communication ties that have already been developed between CAA Colorado and CDPHE. CAA Colorado will also communicate updates and data to CDPHE through required reports and according to recommendations developed in consultation between CAA Colorado, CDPHE, and the advisory board.

Advisory Board

CAA Colorado has been appointed a representative to the Producer Responsibility Advisory Board and will have standing attendance at advisory board meetings to offer consultations as needed. CAA Colorado will continue to engage in regular meetings with the advisory board to consult on aspects of the Program including this plan, annual updates to the minimum recyclable list, and the development and distribution of education outreach services and materials.

Local Governments

CAA Colorado has undertaken a significant amount of communication and coordination activity with local governments and service providers. CAA Colorado will provide a website with education and outreach resources for local governments, service providers, and education and outreach providers to easily access and customize collateral as described in the *Operations Plan: Education and Outreach* Chapter.

CAA Colorado will also host dedicated webinars to support Program implementation for local governments and service providers.

In addition, CAA Colorado plans to inform local governments through connections with groups such as Recycle Colorado, Colorado Municipal League, Colorado Counties Inc., and others.

Service Providers

Service provider relationships are critical to understanding industry needs and the shifting realities of material markets. CAA Colorado will collaborate with collection and post-collection service providers to obtain data, review relevant Program timelines and requirements, discuss expansion opportunities, and more. CAA Colorado will establish regular meetings with trade associations that serve as conduits to service providers (at minimum once per year). CAA Colorado intends to utilize the service provider portal to process reimbursement claims, supported by dedicated CAA Colorado operations staff to facilitate service provider participation and timely reimbursement.

Producers

For all prospective producers, Circular Action Alliance hosts frequent onboarding sessions to help producers better understand the organization and how to determine their registration obligations.

Circular Action Alliance has been hosting a monthly Producer Working Group (PWG) meeting since 2023 and will continue to host dedicated sessions for producers. PWG offers a forum for information-sharing and discussion with producers, providing updates on Circular Action Alliance programs and practical guidance on topics such as deadlines, requirements, registration, reporting, dues-setting, consultations, and more. PWG participants also have access to the Producer Working Group Library, which includes past PWG meeting summaries and materials.

Circular Action Alliance's website also features a Producer Resource Center, which includes registration, reporting, guidance, and information on dues.

Circular Action Alliance Producer Portal will enable secure registration, access to confidential guidance materials, and allow producers to submit their material supply data for annual dues calculations.

Trade Associations and Other Organizations

CAA Colorado will maintain its strong relationship with Recycle Colorado, as its membership spans the entire materials management industry. CAA Colorado will participate in the organization's annual conference as requested, collaborate on educational forums and webinars for Recycle Colorado members, and is open to other forms of mutually beneficial engagement.

CAA Colorado's relationships with NWRA and SWANA are also a key focus, with their members accounting for a large portion of the state's solid waste management sector. CAA Colorado will also continue its relationship with Colorado Chamber of Commerce and look to bolster relationships with organizations such as Colorado Counties Inc. and Colorado Municipal League and others.

Other PROs and Coordination

CAA Colorado will work with CDPHE, LPMA[50] and any other PROs that are interested in submitting Individual Program Plans to develop an interim coordination process that ensures system coherence, addresses any potential gaps or areas of potential conflict, ensures fairness, and that will be publicly accessible and reviewed regularly.

CAA Colorado is tracking all Program development costs that should be shared with future PROs if they launch prior to CAA Colorado's recovery of those start-up costs. CAA Colorado will then track the recovery of these start-up costs over time so that in the event a new PRO launches, CDPHE and CAA Colorado can identify remaining start-up costs applicable to any new PRO at the time of its proposed entry.

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[50] Lubricants Packaging Management Association (LPMA) https://interchange360.com/

17.2 Data Tracking

Excerpt from the Act

CRS 25-17-709 (2)(a) The program report must include the following information from the preceding calendar year:

(IV) the total weight of the covered materials that producers used for products that are sold or distributed in the state;

(VI) the total weight of each type of covered material that is collected and recycled under the program, with the data broken down by: (A) means of collection, including by curbside service or drop-off center or other means; (B) the number of covered entities, by type and by county, serviced through curbside collection; (C) the method used to handle the collected covered material; and (D) geographic area;

(VII) the recycling rate, collection rate, and postconsumer-recycled-content rate for each type of covered material and a description of the organization's process in achieving the minimum rate targets set forth in the final plan pursuant to section 25-17-705 (4)(p);

(X) a list of the names, locations, and hours of operation for curbside services, drop-off centers, and other entities accepting or collecting covered materials under the program;

(XII) a list of the recycling end markets of any covered materials

Approach to Tracking Material Flows

CAA Colorado is developing an internal material flow management system to enable continuous tracking of materials throughout the value chain. This will provide various services, including:

- Data Collection and Storage: Securely collect and store data from external service providers— from collection service providers to post collection services— such as loads and weights of materials received, processed, and shipped, and other inbound and outbound data. It will also include information on environmental compliance. The system will feature secure receipt of transaction data through system-to-system exchanges, file uploads, or secure web-based data entry.

- Data Protection: Robust data security measures that meet the highest standards, including native encryption, real-time event monitoring, field-level monitoring and audit trails, and sensitivity controls.

- Independent Verification: Track and maintain data and disposition reporting to allow easy auditing by authorized external parties.

- Data Reporting: Provide accountability through the service provider portal.

Material Auditing

To ensure a robust chain of custody through the material flow management system, CAA Colorado will track the flow of covered materials throughout the recycling system, using three main types of tracking:

1. Collection Tracking: This will determine whether covered materials end up in commodity bales or landfills.

2. Post-Collection Tracking: This will assess the recycling and capture rates of covered materials delivered to participating MRFs, including audits of incoming material loads and outgoing commodities (both loose and baled). The auditing process will be integrated into the processing service provider agreements and is described in the *Operations Plan: Contamination Reduction* Chapter.

3. Material Tracking Audits: CAA Colorado's end market verification program is structured to conduct audits pertaining to covered material tracking, if requested by CDPHE. This may include random bale tracking to verify chain of custody of materials if requested by the Department. These audits demonstrate and certify that the end markets meet the standards of "responsible" as defined in the Act. This is described in the *Operations Plan: Responsible End Markets* Chapter, and with further detail of REM verification in the *End Markets* Appendix.

Figure 9 illustrates how CAA Colorado will leverage data inputs and outputs to track the flow of materials through the entire recycling system.

Figure 9: Tracking the Flow of Materials (Tons) Through the System
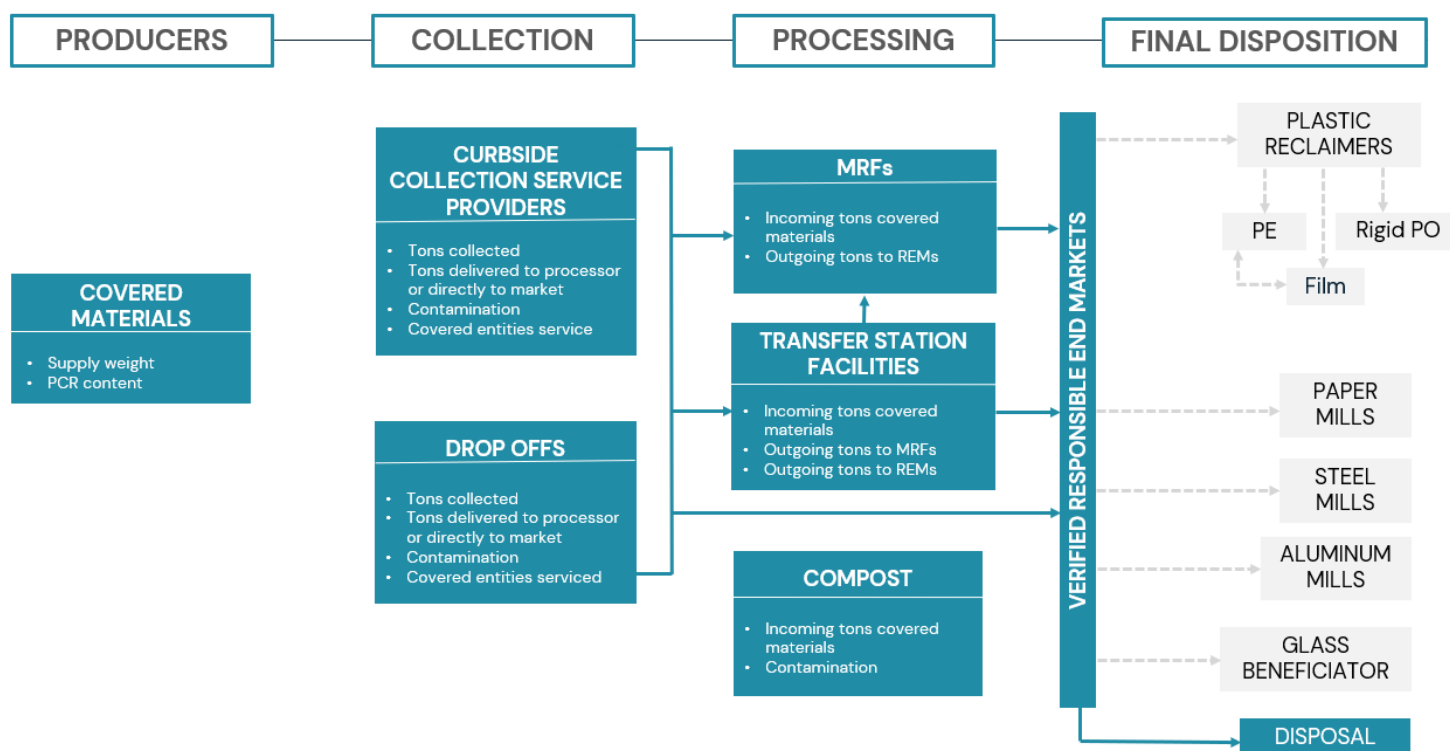
Additional details on the data that will be collected from service providers is included in the *Operations Plan: Service Provider Reimbursement* Chapter, the *Operations Plan: Compostable Packaging* Chapter, the *Operations Plan: Responsible End Markets* Chapter, and the *Operations Plan: Education and Outreach* Chapter.

Financial Audits

CAA Colorado service agreements will allow for periodic financial reviews and audits. The process will be used to ensure financial transparency, compliance, and operational efficiency. The process will safeguard CAA Colorado's financial interests while maintaining a positive, professional, and equitable relationship with CAA Colorado's service providers. CAA Colorado service agreements will include regular financial reviews to validate services and service charges and evaluate cost-effectiveness.

17.3 Services Reporting

Many aspects of this plan will require tracking of metrics to measure and assess the achievement of goals articulated in the *Program Plan Goals* Chapter. CAA Colorado will collect data relevant to the goals, objectives, expected outcomes, and key metrics discussed in that chapter.

CAA Colorado will establish surveys, reporting, and other data collection mechanisms for routine program measurement. CAA Colorado will develop standardized reporting templates for service providers and ensure consistency of data and records and provide clear guidelines to all impacted

entities that are required to report data. CAA Colorado may in some instances pursue studies or other data-gathering exercises to collect essential information. It will use this data and corresponding analytics to improve operations, update its goals, or recommend overall adjustments to Program implementation. CAA Colorado's intention is to use the submittal of its plan updates as the main mechanism for altering program goals.

If requested by CDPHE, CAA Colorado will submit documents and records to the department within ten business days or the timeline specified by the department, whichever is later. This includes documents and records related to the calculation of recycling rates, collection rates, PCR content rates, and any other materials necessary for the department to determine compliance with the Program.

Producer Reporting

Circular Action Alliance will provide participant producers access to the producer portal to submit annual supply data. This will allow for CAA Colorado to capture and aggregate the information that must be submitted to CDPHE in the PRO Annual Report, as well as the applicable individual producer data where required.

Circular Action Alliance will monitor the effectiveness of the producer portal and adjust as necessary to improve efficiency and accuracy. Circular Action Alliance will also provide necessary training and support to all producers and relevant interested groups on the producer portal's use.

Annual Reporting and Amendments to Program Plan

CAA Colorado is required to submit to the advisory board an Annual Report by March 31 of the second year of the Program's implementation, and by March 31 each year thereafter to the advisory board. The Annual Report will contain all information required by the Act[51] to describe progress made on the Program, which will require information sourced from both CAA Colorado and CDPHE. CAA Colorado will deliver the Program's Annual Report each year to the advisory board as a searchable electronic file and will be written in an accessible manner for public scrutiny.

Any proposed amendments to the Program will be included in the Annual Report. At least 60 days prior to the Annual Report deadline, CDPHE may request that CAA Colorado submit an amendment to the Program Plan to address a specific concern. At least 30 days prior to the Annual Report deadline, CAA Colorado will consult with the advisory board on any proposed amendments to the Program Plan. The advisory board will submit any proposed amendments to CDPHE's executive director for approval.

The Annual Report will include the following elements:

1. An evaluation of the impact of producer exemptions and individual program plan materials on Program performance and the producer responsibility dues schedule.

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[51] 25-17-709 (2) (a)

2. A detailed description of the progress toward each element of the Program.

3. A list of all the producers, brands, and covered materials covered by the final plan.

4. A list of known producers that are not participating in the Program and any producers that may be non-compliant with obligations. The Act states that a Producer Responsibility Organization may not make any determination as to a person's compliance with the Program[52], additionally CAA does not determine whether a company is defined as a producer. It is up to individual companies to determine if they are producers. For the purposes of this section of the annual report, CAA will rely on CHPHE's report of non-compliant companies that may be producers.

5. The total weight of covered materials that producers used for products that are sold or distributed in Colorado.

6. The total amount of producer responsibility dues collected under the Program, including an annual schedule of those dues assessed by weight for each type of covered material, any annual increases or decreases in the dues schedule and the reasons.

7. The total weight of covered materials collected and recycled under the Program, broken down by:

   a. Means of collection, including curbside service or drop-off center or other means.

   b. The number of covered entities, by type and by county, serviced through curbside collection.

   c. The method used to handle the collected covered material.

   d. The geographic area.

8. The recycling rate, collection rate, and postconsumer-recycled-content rate for each type of covered material and a description of the organization's process in achieving the minimum rate targets in the Program.

9. The rate schedules for reimbursement to service providers, any proposed adjustments to the rate schedules, and a summary of any rate-related disputes between CAA Colorado and service providers, and how the disputes were addressed. CAA Colorado will work with CDPHE to keep any proprietary or business sensitive service provider information confidential and will share information publicly in aggregate when appropriate.

10. A summary of education and outreach efforts, including examples of distributed materials, a description of the methodology used, and the results.

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[52] 25-17-705 (7)

11. A list of the names, locations, and hours of operation for curbside services, drop-off centers, and other entities accepting or collecting covered material under the Program.

12. A list of the recycling end markets of any covered materials, and, if the covered materials are processed through a method other than mechanical recycling:

    a. A description of how the method will affect the ability to recycle the covered material into feedstock for the manufacture of new products.

    b. A description of how the method will increase the types and amounts of recycled plastic for food and pharmaceutical-grade packaging and applications.

    c. A description of any applicable state and federal air, water, and waste permitting compliance requirements for the method.

    d. An analysis of the environmental impacts of the method compared to the environmental impacts of incineration of solid waste in landfills.

13. A copy of an independent third party's report auditing the Program. This audit includes a detailed list of the Program's costs and revenues from the producer responsibility dues. Results of any material tracking audits conducted during the reporting period will also be included. CAA Colorado will work with CDPHE to ensure that the timing of the audit report meets the requirements of the act.

14. A description of the status of reserve funds, an assessment of the adequacy of those funds to cover Program costs, and a description of how any Program shortfalls will be addressed.

15. Any amendments to the Program.

16. Any updates to the minimum recyclable list.

17. A description of the advisory board's feedback on any amendments to the final plan.

Needs Assessment

CAA Colorado will develop a plan proposal for 2031 to 2035. To accomplish this, CAA Colorado will conduct a needs assessment, unless this requirement is waived by CDPHE. On or before May 1, 2029, CAA Colorado will hire an independent third party approved by CDPHE to conduct this assessment of the state's recycling needs to reevaluate the Program and identify any recycling service needs in the state that are not met by the Program. The findings of this needs assessment will be used to create the 2031 to 2035 plan proposal that will be submitted to the advisory board in accordance with the Act. The 2031 plan will describe in detail how the organization will continue to increase the state's minimum collection rates, recycling rates, and PCR rates after 2030. The 2036 to 2040 plan will address increasing rates beyond 2035.

17.4 Producer Compliance

> **Excerpt from the Act**
> 25-17-705 (4)(e) describe how the organization will track compliance among producers and will collaborate with the executive director to bring producers into compliance

Producer Engagement

CAA is undertaking robust producer engagement activities to educate producers of their obligations prior to the start of the Program. This includes direct outreach to producers, webinars, and engagement with relevant trade associations to drive broad awareness of Program requirements. CAA will also develop additional guidance materials to facilitate accurate and timely producer supply reports. These efforts are intended to reduce non-compliance and support CAA's internal compliance processes.

Compliance Policies

CAA will develop a set of binding agreements and policies (Policies) that clarify producer obligations for registration, reporting and dues payments. Policies will specify requirements for producer registration, reporting and dues payment, and may address additional issues such as reporting timelines and categories, details of exemptions, correction of errors in reports, membership-initiated adjustment requests, billing and invoicing, timing of dues payments, interest and damages associated with late payments, verification audits, voluntary reporting agreements, and other compliance processes along with a timeline by which a non-compliant member would be referred to the CDPHE's executive director for potential disciplinary action and/or dispute settlement.

CAA policies will also include the following duties of participant producers:

- Duty to Pay Required Dues: CAA may impose financial interest or liquidated damages on producers for failure to pay invoices in accordance with Policies.

- Recordkeeping Obligations: CAA members will be required to retain records to substantiate and verify the accuracy of the information submitted in their reports for a five year period following the submission, and such records will be subject to inspection by CAA.

- Duty to Comply with Requests for Documentation: Upon written request from CAA, participant producers shall provide documentation in support of their reports to CAA. This may include specific data, detail on calculation methodologies, and/or audit reports, among other items.

- Duty to Provide Access: Participant producers will be required to grant access during business hours to CAA or its authorized representatives to inspect and review records

relevant to information submitted in their reports as maintained in accordance with the Retention of Records policy.

- Duty to Cooperate with a Verification Audit: At the request of Circular Action Alliance, participant producers must cooperate with CAA's verification process, described in the *Responsible End Markets* Chapter of this plan. This may include providing requested documentation, data, records, and reports within a reasonable timeline of such requests, providing confirmation from a senior officer with authority to confirm and oversee reporting, and providing access to the member's business premises.

Monitoring Compliance

CAA's website will feature a list disclosing all participating producers, and CAA Colorado will keep CDPHE regularly appraised of additional participant producers that register within Colorado. A list of registered producers was shared with CDPHE on October 31, 2024, and with the submission of this plan. This list will also be updated when the first producer dues are published on or before November 1, 2025. Beginning in 2026, CAA Colorado plans to update the list on a quarterly basis. CAA Colorado anticipates that the list will be updated by the 15th of each month following the close of a calendar quarter (i.e. the 15th of October, January, April).

Upon registration, CAA will monitor producer compliance with the Act, the Program, and CAA Policies by tracking compliance status against requirements and conducting periodic audits of producer records and reports.

In instances where a participant producer is potentially non-compliant with CAA Policies, the Program and/or the Act, CAA will notify the producer of the noncompliance and work with the producer to resolve the noncompliance in a timely manner. This may include a suspension process, subject to a time frame outlined in the Policies. For example, participants who failed to report and/or pay dues within the specified time frame could be suspended by CAA and considered noncompliant producers.

CAA Colorado also proposes that in a multiple PRO situation, a searchable online database be maintained by CDPHE, where PROs could confirm whether producers were members of an approved PRO and in compliance with CDPHE requirements. This tool would help streamline compliance verification.

Escalation and Enforcement

When noncompliance persists despite CAA's internal efforts, escalation to, and collaboration with, the executive director may be necessary to ensure compliance with the Act. In those cases, after CAA has notified the impacted participant producer and provided a reasonable opportunity to cure, CAA Colorado will escalate the noncompliance to the executive director for enforcement when Circular Action Alliance remedies have not resolved the issue. If unresolved noncompliance is escalated, CAA Colorado expects that the executive director will enforce compliance to bring the noncompliant producer back into alignment with the Act the Regulations, Department policies,

and/or Circular Action Alliance policies. Once escalated, the executive director will follow the process outlined in Section 18.11 of the regulations. This process is separate from CAA's internal process. CDPHE's process may include penalties determined and enforced by the executive director.

CAA Colorado's Annual Report will also utilize CAA's compliance monitoring to present a list of producers not compliant with the Program, i.e. any producers that may be out of compliance due to issues like late registration, late reporting, underreporting, not providing requested detail on reporting methodologies or data, incorrect reporting, or late payment.

CAA Colorado may also become aware of producers that are not CAA participants but that appear to be obligated producers under the Act. CAA will conduct outreach to encourage such producers to register with the PRO to fulfill their obligations under the Act. In such situations, however, CAA Colorado may not necessarily have access to information that would confirm whether a non-participant producer is obligated under the Act. If such producers fail to act, CAA Colorado will refer these producers to the executive director, along with the information that led it to believe the producer was obligated under the Act, for the executive director to take enforcement action as it may deem necessary.

CAA report validation may identify situations where there is a dispute between producers about which entity is an obligated producer with respect to a particular material obligation. In such circumstances, CAA Colorado may consult with the executive director regarding the interpretation of the Act's "obligated producer" provisions to ensure that the application of the Act to producers is consistent with CDPHE's intentions.

CAA will develop a set of policies related to dues payments and reporting requirements that will be accessible to all participating producers. Policies will specify producer reporting and dues payment obligations, and may address such issues such as voluntary reporting agreements, reporting timelines and categories, reporting errors, membership-initiated adjustment requests, billing process, timing of fee dues payments, penalties and interest associated with late payments, verification audits process, and compliance process, along with a timeline by which a non-compliant member would be referred to the CDPHE for potential disciplinary action or dispute settlement. Compliance policies and processes will remain internal to CAA and will be submitted to CDPHE upon request.

For any program year that a producer is found to be non-compliant because they are not reporting, reporting inaccurately and/or not paying dues, the producer will retroactively pay all dues during the period they were obligated, including all applicable late or inaccurate reporting charges. Each reporting year, the dues are set after the reporting deadline for the next program year. Once these dues are set for a given program year, they are final and not updated or adjusted as adjustments, corrections, or late reports come in from producers. Any data received would be accounted for as part of the next reporting cycle and thus factored into future dues-setting.

17.5 General Policies, Procedures, and Practices

CAA will regularly monitor the execution of the Program. CAA recognizes that defined and consistently executed policies, procedures, and practices are critical for ensuring contracts are valid, personnel are safe in the workplace, data is secure, and all Program objectives are achieved.

CAA has developed national and state-specific policies, procedures, and practices to enable consistent and effective execution of the Program. Consistent with best practices, CAA anticipates that it will periodically review and update its policies, procedures, and practices as determined to be necessary or appropriate. As required by the Act, CAA policy dictates that the organization will not use any Colorado producer responsibility dues to pay employee bonuses to CAA Colorado staff.

If requested by the department, CAA Colorado will submit documents and records to the department within ten business days or the timeline specified by the department, whichever is later. This includes documents and records related to the calculation and payment of producer responsibility dues.

Management of Contracts

CAA Colorado will maintain appropriate records of contracts, and written contracts between CAA Colorado and relevant parties will undergo appropriate internal review, before execution.

Workplace Safety and Conduct

CAA Colorado will comply with all applicable laws pertaining to workplace safety. CAA Colorado is committed to maintaining a safe and healthy work environment by requiring personnel to comply with established safety and workplace conduct standards. CAA Colorado will provide proper equipment, procedures, and training. Failure to adhere to safety and conduct rules could result in disciplinary action, up to and including termination of employment. CAA Colorado will promptly and thoroughly investigate all reports of suspected non-compliance with safety or conduct requirements.

Environmental Justice

The United States Environmental Protection Agency defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. While the Act does not have explicit Environmental Justice requirements related to Program Plan, they are implicit including specifically:

- The provision of convenient and equitable access to recycling services to covered entities for all readily recyclable materials, at no charge.

- An education and outreach program that provides clear and concise recycling instructions that are consistent statewide and accessible to all demographic groups.

- Annual reporting requirements that seek to track gaps.

CAA Colorado's Program and service delivery will ensure that all covered entities have access to recycling services as required by the Act. The service agreements will include language related to compliance with relevant state environmental laws, regulations and policies. CAA Colorado's education and outreach program encompasses all areas of the state through the utilization of a variety of mediums and platforms to reach and engage all communities. The education and outreach efforts will focus on accessibility including publication in multiple language, compliance with state accessibility standards, and ADA compliance. CAA Colorado's interest holder engagement will be designed to promote meaningful involvement of all people in the state, regardless of race, color, national origin, or income. CAA Colorado will also track and report on program elements annually to evaluate performance. When needed, CAA Colorado will adjust the program delivery to meet the aims of the program including environmental justice.

Confidential Information and Retention of Information

As CAA Colorado is likely to obtain commercially sensitive data from various program participants, it will adopt an information security specification that outlines appropriate technical, physical, and organizational measures designed to protect against unauthorized or accidental access, destruction, loss, alteration, or disclosure of private information. These measures will address native encryption of all data, event monitoring, audit trails, and other relevant topics. When information is no longer needed or required to be maintained, CAA Colorado will securely dispose of all data and records in accordance with its records retention policy and information security program requirements. All relevant personnel will be required to periodically undergo appropriate training to protect confidential information.

As required by the Act, CAA Colorado will preserve books and retain records related to the implementation and administration of the Program in accordance with state law for at least five years and make them available for inspection by CDPHE upon request. All documents are stored and managed by Circular Action Alliance's national organization within CAA Colorado's internal systems. This architecture ensures secure access, maximizes uptime, and maintains backups for all critical information. A copy of CAA Colorado's records retention policy is available upon request. CAA Colorado will designate a records custodian who will be responsible for the administration of the records retention policies.

Closure Plan

Excerpt from the Act
25-17-705 (4)(n) describe a plan that outlines, if the organization ceases to exist or ceases to administer the program, how any producer responsibility dues that have not been used to implement the program will be transferred to another organization designated by the executive director under subsection (1)(b)(ii) of this section to administer the program or will be transferred to the fund to be managed by the department until transferred to another designated organization.

CAA Colorado financing proposals include the development of Program reserve targets not to exceed six months' operation costs. Recent experience with the wind up of several stewardship programs suggests that the six-month reserve policy will provide an ample buffer for covering all CAA Colorado obligations related to a potential closure of its Program.

Closure scenarios related to CAA Colorado operations involve several potential scenarios, which may include but are not limited to:

1. A decision by the Circular Action Alliance Board of Directors to cease operations in Colorado. In the case of an internal Circular Action Alliance decision to cease operations in Colorado, CAA Colorado will endeavor to give its producers, service providers, CDPHE, and local government entities a minimum of six months' notice that it intends to cease operations in Colorado. Circular Action Alliance would also endeavor to make such a decision, if suitable under the circumstances, with the renewal dates associated with the Act.

2. Failure to maintain minimum standards in Colorado's Producer Responsibility Program for Statewide Recycling Act.

3. Changes in relevant laws, regulations, or other by other Act requirements. Circular Action Alliance assumes that a change to the statutory and/or regulatory framework requiring the organization to cease operations in Colorado would likely be accompanied by conditions that provide notification and timing of required Program termination dates. As such, this closure plan will focus on the other two possible closure scenarios.

A notice of closure would include the intent to terminate Circular Action Alliance's Colorado Program, the anticipated termination date, and an outline of the steps CAA Colorado would take to wind up its operations in an orderly fashion.

The Colorado closure plan will include the following information:

*   Key steps and activities CAA Colorado will undertake before and after the termination date to ensure:
    o   That Producer Responsibility Program for Statewide Recycling obligations has been maintained during the wind-up of activities.
    o   That service providers, local governments, and others are given adequate notice of the wind-up of individual CAA Colorado programs and contractual arrangements.
*   Implementation timelines, key steps and cut-off dates for various Program operations (for example, final day to submit reimbursement claims).
*   A communications plan, including the process CAA Colorado will follow to notify impacted parties.
*   A plan to transfer all producer data to another PRO designated by CDPHE. If no PRO exists, CAA will coordinate with CDPHE on the development of a compliance database or other means of sharing information and transfer the producer data to CDPHE.

- A closure financial plan and budget, including the process to resolve any liabilities or tax and other financial issues, including:
  - A plan to disburse any remaining assets and reserves once all financial and operational obligations have been addressed.
  - Transfer of any remaining dues to another organization designated by the executive director or to a fund that is managed by CDPHE.

Note that to cease operations, CAA Colorado will have to conduct several activities after the termination date, including final payments for activities that took place prior to the termination date, as required in the Act. Once CAA Colorado completes the steps required under the closure plan, it will provide notice to CDPHE of the completion of the plan.

EXTENDED PRODUCER RESPONSIBILITY (EPR): FINAL PLAN OVERVIEW

Circular Action Alliance®

Circular Action Alliance (CAA) Colorado developed a five–year roadmap (2026–2030) to transform recycling across the state. The **final plan** was created in response to House Bill 22–1355, which requires companies that sell packaging and paper products in Colorado to take responsibility for what happens to those materials after use. The goal is to make recycling easier, more effective and more widely available, benefiting Colorado's communities, natural beauty and economy.

RECYCLING GOALS UNDER EPR

CAA Colorado aims to improve Colorado's low recycling rates and limited recycling access. With producers taking responsibility for their packaging, the program also encourages less waste and more sustainable product design.

Increase recycling rates from **25%** to **55%** by **2035**.

25%
2022

41%
2030

55%
2035

BENEFITS FOR COLORADO

Less Landfill Waste
By prioritizing recycling, composting and reuse/refill, the program reduces landfill waste while creating cleaner air, water and landscapes.

Equitable, No–Cost Recycling
Producer-funded recycling gives all Coloradans free, convenient access, no matter where they live.

Local Business Growth
Infrastructure and end market investments support local businesses, create jobs and build a reliable recycling system.

Clear Education and Outreach
Residents learn what to recycle or compost and how items are reused, supporting participation statewide.

EXTENDED PRODUCER RESPONSIBILITY (EPR):
FINAL PLAN OVERVIEW

Circular Action Alliance®

HOW EPR WORKS IN COLORADO

PRODUCER RESPONSIBILITY

Companies selling packaging and paper in Colorado pay dues based on the type and amount of materials they provide. These dues fund the full recycling system, including collection, processing, education and infrastructure.

CENTRALIZED, STATEWIDE SYSTEM

CAA Colorado will coordinate statewide recycling by partnering with local governments, private providers and community groups. The plan standardizes what materials are recyclable and makes recycling convenient as trash collection.

EXPANDING ACCESS AND SERVICES

Residential & Non-Residential: The program begins with residential recycling and adds schools, government buildings, public areas, hospitality venues and small businesses by 2030.

Rural Investments: Funds will expand or upgrade recycling infrastructure in rural and underserved regions.

Compostable Packaging: The plan supports composting for certified compostable packaging and provides education to reduce contamination and boost recovery.

Reuse and Refill: Incentives for producers to offer at-home refill packaging and innovative designs mean more sustainable choices for consumers.

EDUCATION AND OUTREACH

A key focus is public education, showing people what to recycle, why it matters and how to avoid contamination. Outreach will build on Colorado's successes and be tailored to diverse communities through targeted campaigns, events and partnerships.

INNOVATION AND IMPROVEMENT

CAA Colorado will regularly review and update the program, using data and public feedback to improve recycling rates, add new materials and support innovative solutions like reusable packaging and increased use of recycled content in new products.

HOW IMPLEMENTATION BEGINS

Initiatives will roll out gradually, giving communities and businesses time to adjust to the new system.

Reimburse for existing curbside service

Boost participation where access exists

Enhance systems and recycle more items

Build capacity in underserved areas

Scan or Click to Read the Final Plan

By **2030**, recycling in Colorado should be just as **convenient as trash pickup**.

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Town Council

Board Meeting Date: 2/3/2026

File #: 2026-68, **Version:** 1

SUBJECT:
Resilience Action Plan Next Steps

DEPARTMENT: Environmental Services

PRESENTER(S):   Emma Marino, Sustainability & Water Conservation Specialist
Eryka Thorley, Sustainability Division Manager

TIME ESTIMATE: 15 minutes

FISCAL SUMMARY:
N/A

POLICY ISSUES:
Erie's first Resilience Action Plan supports resilience related goals and best practices identified in Erie's 2019 Sustainability Plan, 2025 Beneficial Electrification Plan, 2024 Comprehensive Plan, and 2023 Home Rule Charter. Additionally, it supports the in-progress Sustainability Action Plan update which identified resilience as one of its four main guiding principles. Respondents to the 2025 Community Survey listed Sustainability Programs (water conservation, solar/renewable energy, waste diversion, etc.) as the highest priority in terms of how much focus and effort the Town should dedicate (outside of essential services like police, water, sewer, and streets).

STAFF RECOMMENDATION:
Staff request direction regarding any needed clarification or changes to the Draft Resilience Action Plan prior to bringing it to Council for adoption.

SUMMARY/KEY POINTS
- The Resilience Action Plan (RAP) Draft was presented to Council in a study session on Oct. 7, 2025, then returned as a Consent Item on Nov. 18, 2025.
- At the Nov. 18 meeting, some Council Members expressed concerns regarding potential added costs to new development in Erie, specifically within the Unified Development Code and general code updates.
- The RAP identifies possible strategies to explore and does not mandate any specific actions. It is intended to establish a strategic focus on resilience research and engagement in Erie.
- In late 2025, the Sustainability Division was chosen to work with a second group of CU

Boulder students to further explore specific resilience strategies in Erie (specifically HOA pilot workshop series, extreme heat events, and/or identification and research resilience hub potential locations and next steps).

BACKGROUND OF SUBJECT MATTER:

Erie's first Resilience Action Plan (RAP) was designed to strengthen the Town's ability to adapt, thrive, and grow in the face of climate, economic, and social challenges. The Plan identifies risks and adaptive strategies for the Town to explore to improve community preparedness for extreme weather events and social vulnerabilities. Erie stands at a pivotal point in its development with evolving environmental concerns, population growth, and increasing infrastructure demands. The Plan outlines a forward-looking vision with actions to explore to ensure the Town remains secure, sustainable, and equitable into the future.

The three key areas for building long term resilience in the Plan include the following:
1. Infrastructure
2. Land Management
3. Community

Each chapter provides background on the topic, a list of current progress, accomplishments, goals, strategies, and potential community partnerships.

The Town is working with a second University of Colorado Boulder Masters of the Environment cohort to further explore implementation opportunities from this initial plan and develop an Implementation Guide. The Guide will include at least one of the following focus areas:
1. A Homeowner's Association (HOA) resilience workshop series, targeting Erie's neighborhood communities to learn more about and begin strategic implementation to increase resiliency across the Town.

2. Identifying sites that could serve as resilience hubs including analysis as to why the location would be a good fit, documenting community engagement strategies, an existing and lacking resource assessment, and related mapping.

3. Develop an implementation plan to increase resilience during extreme heat events for the Town of Erie. This could include creating a guide for this hazard, strategic mapping, co-benefits such as nature-based solutions, researching specific impacts in Erie and current conditions, working with local HOAs and partners to create and deliver related education and outreach materials.

Staff would appreciate Council direction on whether the presentation and attachments address Council Members' initial concerns regarding the Resilience Plan and potentially increasing the costs of new development. Based on Council direction, staff will prepare a final RAP for Council adoption and support with the current Sustainability Action Plan update, which staff will bring to Council later this year.

ATTACHMENT(S):
1. Presentation
2. Draft Resilience Action Plan
3. Cost Impact of Energy Efficiency Codes and Building Electrification Memo 1.30.26.docx
4. Rocky Mountain Institute - Economics of Electrifying Buildings 2018
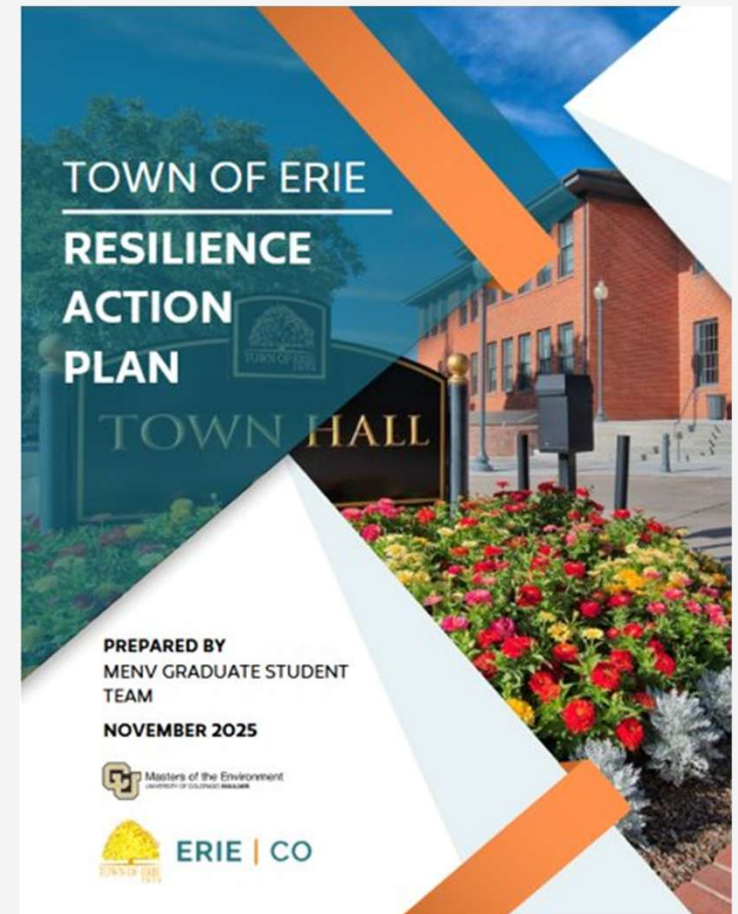
Resilience Action Plan (RAP)

Town Council Check In

Feb. 3, 2026

Eryka Thorley & Emma Marino
Town of Erie Sustainability Division

Presentation Overview

1. RAP High Level Summary

2. RAP Implementation

3. Council Direction

4. Next Steps

TOWN OF ERIE

RESILIENCE
ACTION
PLAN

TOWN HALL

PREPARED BY
MENV GRADUATE STUDENT
TEAM

NOVEMBER 2025

Masters of the Environment
UNIVERSITY OF COLORADO BOULDER

ERIE | CO

Project Purpose

Create Erie's first Resilience Action Plan

"Community resilience is defined as the ability of a community to recover from a disaster or persist sustainably in the face of a new, ongoing hardship." -Town of Erie, Sustainability Division

The United States Chamber of Commerce estimates that for every $1 spent on resilience work, $13 is realized through avoided future impacts in economic loss and infrastructure rebuilding.

Vulnerability Assessment

Air Quality

Drought

Extreme Heat

Flooding

Wildfires

Social Vulnerability

Community Engagement

Arbor Earth Day
194 interactions

Town Fair
250 interactions

Farmers Markets
378 interactions

Erie Fest
104 interactions

Resilience Action Plan Chapters

Resilient Infrastructure

Build infrastructure able to withstand and operate during natural hazards and decrease the need for post-disaster rebuilding.

Land Management

Maintain public and private lands to protect local biodiversity, stormwater management, and recreation opportunities.

Community

Provide accessible resources to give Town residents the opportunity to succeed through safety, connectedness, and health.

Questions Raised

- Concerns for increased cost to new development
  - All strategies mentioned are suggestions, not mandates, to explore further to ultimately increase resilience in Erie.
- Concerns for increased cost due to changes to the Unified Development Code (UDC)
  - Agrivoltaics are the only mention to updating the UDC
    - Potential UDC update could allow for this economic driver to be utilized by farmers/agriculture zones in Erie, creating a second revenue source while also increasing the resiliency and yield of many crops and reducing water demand.

Council Direction

- What specific questions does Council have?

- What remaining concerns exist regarding the plan's exploratory strategies and potential increased costs to new development in Erie?

- How can staff best adapt the draft plan to meet the priorities of the Council?

Next Steps

- The Sustainability Division matched with a second MENV cohort to dive deeper into resilience implementation.
  - Next phase focus areas will include:
    - Developing a HOA resilience engagement workshop.
    - Resilience hub site analysis and research.
    - And/or developing an extreme heat community resilience plan.
- This next phase kicked off late January 2026 and will continue through the fall.
- We will incorporate Council feedback into the RAP and bring this back to Council for final adoption soon.

Questions

- If you have questions or concerns, please email the Sustainability Division at **SustainableErie@erieco.gov**.

TOWN OF ERIE

RESILIENCE ACTION PLAN

PREPARED BY

MENV GRADUATE STUDENT TEAM

NOVEMBER 2025

CU | Masters of the Environment
UNIVERSITY OF COLORADO **BOULDER**

TOWN OF ERIE
1874

ERIE | CO

Table of Contents

Acknowledgements

The Town of Erie Sustainability Division acknowledges that the Town of Erie occupies the ancestral homelands of the Hinono'eino (Arapaho), Núu-agha-tʉvʉ-pʉ (Ute), and Tsitsistas (Cheyenne) peoples, among others who have lived on and cared for this land for countless generations. We honor the people, their history, their culture, and their enduring connection to this place we now call Erie. We also recognize that Indigenous peoples are still here today, and we commit to learning from their resilience and stewardship as we strive toward a more inclusive and respectful future.

Town of Erie Divisions and Groups

External Community Partners

Organization	Name	Title
Being Better Neighbors	Christina Pisano	Board Member
City of Boulder, Public Works – Utilities Department	Heather Bearnes-Loza	Water Conservation Program Manager
City of Lafayette, Sustainability Department	Elizabeth Bocon	Sustainability Director
Erie Community Food Bank	Robin Kitlowski	Co-Director
Lotus Engineering and Sustainability	Molly Marcucilli	Climate and Building Policy Associate
Lotus Engineering and Sustainability	Natalia Carminelli	Communications and Engagement Associate
Monarca Group	Berenice El Gharamti	Co-Founder and Managing Partner
Mountain View Fire Rescue	Paul Ostroy	Fire Management Officer

How To Use This Plan

This plan is designed for easy navigation via the clickable sections within the Table of Contents. Page numbers are located at the bottom-right of each page. A broad overview of the plan can be found within the Executive Summary and Plan Creation Timeline. The Community Engagement Recap and Community Engagement Timeline sections provide insights into how the team consulted residents and visitors at a variety of local events. The Vulnerability Assessment Summary provides a brief overview of major findings from the Vulnerability Assessment, included in full in Appendix A. The majority of this document consists of goals and strategies captured within three chapters, followed by a short "General Initiatives" section. Each of the three chapters contains background information, current Town progress and initiatives, overarching goals, and recommended strategies that support goal achievement. Hyperlinks, found throughout the document, are underlined.

Within each goal is a "Concept" note which provides a brief explanation of the benefits of the goal and the rationale for its inclusion. For instance, the goal of an increased tree canopy provides benefits related to extreme temperatures, air quality, and stormwater management, and those benefits are noted in the "Concept" within that goal.

The plan concludes with a glossary of definitions and acronyms and a list of references. Appendices include the complete Vulnerability Assessment and full results of community engagement efforts.

For readers with limited time and a specific area of interest, the three chapters are broken into smaller sections that are listed in the Table of Contents. For instance, someone wanting to learn more about air quality initiatives can proceed directly to the Air Quality section within the Infrastructure chapter. This presentation by section will support Town staff and other users as they locate sections pertinent to their areas of influence. Each section concludes with partnership opportunities, making these strategies key for understanding how individuals and organizations outside of the Town can contribute to the effort.

Old Town Erie, Colorado.[2]

Executive Summary

The Town of Erie, Colorado, is proud to present its first ever **Resilience Action Plan (RAP).** This new plan is designed to strengthen the Town's ability to adapt, thrive, and grow in the face of climate, economic, and social challenges. Through this plan, risks and adaptive strategies were identified for the Town that improve community preparedness for extreme weather events and social vulnerabilities. Erie stands at a pivotal point in its development with evolving environmental concerns, rapid population growth, and increasing infrastructure demands. The RAP outlines a forward-looking vision with concrete actions to ensure the Town remains secure, sustainable, and equitable in the future.

This plan is grounded in an understanding of Town priorities, research, environmental sustainability, and best practices for long-term growth. Development of the plan was supported by a Vulnerability Assessment conducted by the University of Colorado Boulder's Masters of the Environment (MENV) Graduate Student Team. This assessment evaluated environmental risks and social equity hazards and was complemented by robust community engagement. Town staff, local and regional partners, and Erie residents played a vital role in shaping the recommendations presented in this plan. A summary of these community interactions can be found in the Community Engagement Recap.

The **three key areas** for building long-term resilience that are included in this plan are:

Infrastructure   **Land Management**   **Community**

Each chapter provides background on the topic, a list of current progress, accomplishments, goals, strategies, and potential community partnerships. In addition to these chapters, there is a short "General Initiatives" section.

Plan Creation Timeline

1. **Literature Review: April to June, 2025**
   a. The MENV Graduate Student Team reviewed Town of Erie plans for reference and information and looked at plans from nearby Colorado municipalities. The team also examined plans from locations across the United States to understand best practices and formatting.
2. **Creation of the Vulnerability Assessment: June to July, 2025**
   a. The Vulnerability Assessment was created to inform the priorities of Resilience Action Plan goals and strategies.
3. **Community Engagement: May to August, 2025**
   a. See the Community Engagement Recap or more information. Also, see Appendix B for data from Community Engagement.
4. **Community Partner Interviews: June to August, 2025**
   a. See the Community Engagement Recap.
5. **Creation of the Town of Erie Resilience Action Plan: July to October, 2025**
   a. Goals, strategies, and partnership opportunities were developed after the culmination of all the research, community engagement, and interviews.

Literature review of Town plans and similar local plans

Tabling events to connect with Town residents

Creation and finalization of the Resilience Action Plan

Creation of a vulnerability assessment

Interviews with Town staff and external partners
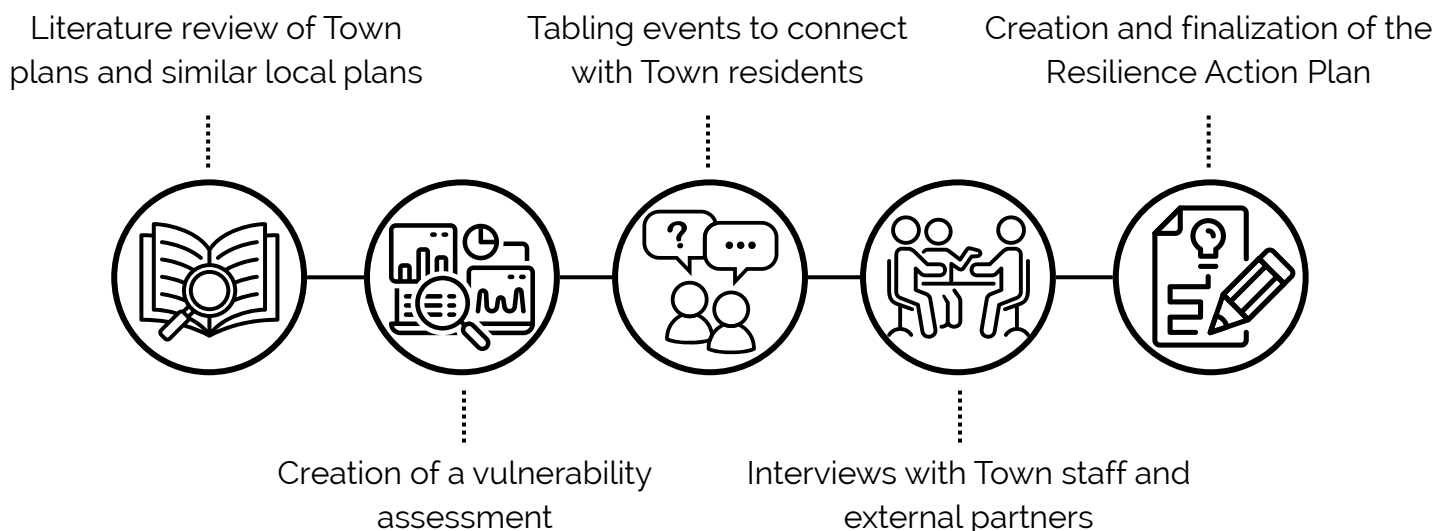
Timeline of the steps the MENV Graduate Student Team took to create the Resilience Action Plan.

Community Engagement Recap

The MENV Graduate Student Team interviewed Town staff from various departments and divisions, local partners, regional partners, emergency responders, and Town Council members. The expertise and personal stories from interviewees provided the MENV Team with an understanding of where the Town needs the most support in improving its resilience efforts.

In addition to interviews, the MENV Team received community input at multiple Town events in collaboration with the Town of Erie's Sustainability Division and Sustainability Advisory Board. The MENV Team created three questions to generate meaningful resilience conversations and data collection. The data provided insight for the priorities of the Town's first Resilience Action Plan. The questions were presented with the same approach at each engagement event along with color coding to identify Erie resident and nonresident responses. An estimated 928 people interacted with these questions at eight separate events during the creation of this plan.

The first question was "In your opinion, what should be the top three priorities for Erie to build local resilience?" Respondents were instructed to mark their top three choices. The choices included:

- Energy Resilience (backup for power outages)
- Sustainable Land Use and Transportation Access
- Wildfire Mitigation and Disaster Response
- Local Ecosystems, Wildlife, and Trees
- Water Conservation
- Economic Diversity and Job Access

- Agricultural Support
- Community Connectedness and Education
- Healthcare Access
- Other

The most common response for the first question was local ecosystems, wildlife, and trees, which obtained 20% of the total vote. Sustainable land use and transportation access was a close second place with 19% of the vote.

Top Identified Priorities
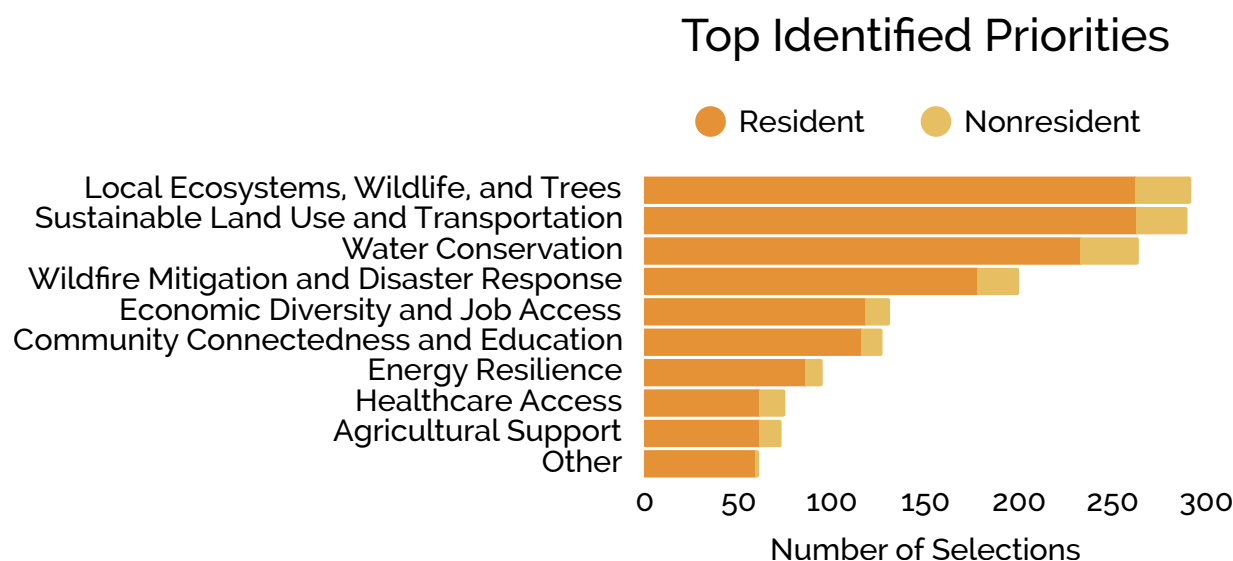
Graph for responses to the top identified priorities across all Town events the MENV Graduate Student Team attended.

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The second question was "What are the top three hazards that Erie is most vulnerable to?" Respondents were instructed to mark their top three choices. The choices included:

- Extreme Heat
- Flooding
- Drought
- Wildfires
- Power Outages
- Not sure
- None
- Other

The most common response for the second question was drought, which received 26% of the total vote. Wildfires was second with 25% of the vote.

Top Identified Hazards
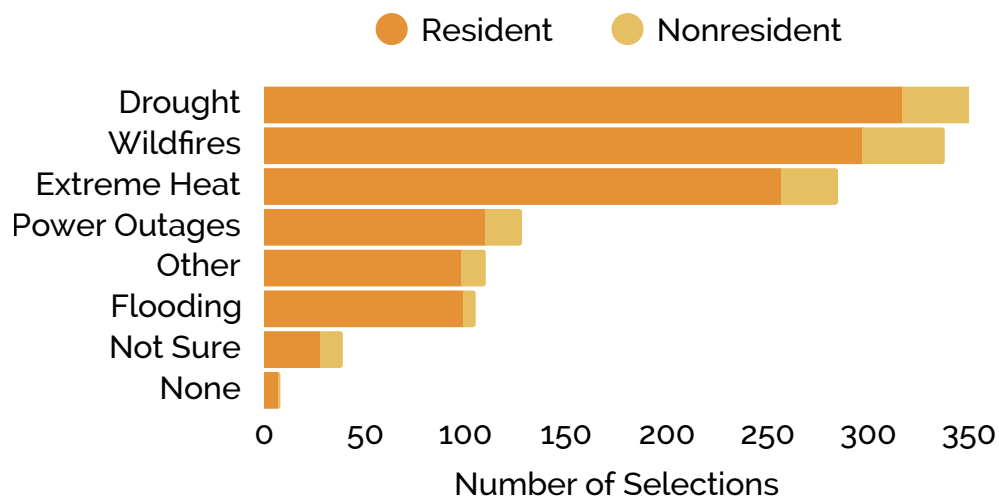
Graph for responses to the top identified hazards across all Town events the MENV Graduate Student Team attended.

The third question was "What is your definition of resilience?" This was an open-ended question for which respondents provided their written perspective.

The entirety of the results and data from this community engagement effort can be found in Appendix B.

Community Engagement Timeline

MENV Graduate Student Team at Arbor/Earth Day.

1

Arbor/Earth Day
April 26, 2025

The celebration of Erie's 27th Annual Arbor/Earth Day event spread awareness of the Town's conservation efforts. Free trees, prizes, a poster contest, talks from politicians, and food trucks were all a part of the celebration.

Town Fair
May 17, 2025

The 28th annual Town Fair was held by the Erie Chamber of Commerce to celebrate local businesses and resources. Arts, crafts, food, drink and community building were highlighted in this event.

2

MENV Team Member talking to Erie resident at the Town Fair.

3

MENV Team Member talking to residents at a Town of Erie Farmers Market.

Town of Erie Farmers Markets
May to July 2025

The Town of Erie Farmers Market provides local Colorado farms and vendors with a popular and inviting market to showcase their products. This market connects residents with local produce and expands business opportunities for farms and vendors.

Erie Fest
August 2, 2025

This was the first Erie Fest in Town history. The event was hosted by Being Better Neighbors and highlighted multiple cultures to build a more cohesive and welcoming community.

4

MENV Team at Erie Fest. 10

Vulnerability Assessment Summary

As part of the creation of this document, the MENV Graduate Student Team prepared an assessment of hazards within and surrounding the Town, as well as of the vulnerability of Town populations. The following is a short summary of this document, which is appended in its entirety at the end of the plan.

Purpose and Methodology

The Town of Erie is facing increasing climate-related risks that threaten its residents, environment, and economy. This report focuses on five key hazards: air quality, drought, extreme heat, flooding, and wildfires. The goal of this assessment is to provide a scientific and historical context for each hazard, analyze vulnerabilities, and provide a rationale for the establishment of relevant goals and strategies that address them.

Vulnerability is defined by exposure, sensitivity, and adaptive capacity.[3] The report also highlights the interconnections between hazards, such as drought increasing wildfire risk due to drier fuels, which in turn raises flood risk.[4]

Climate Hazards

Air Quality

Erie's air quality is impacted by ground-level ozone and particulate matter (PM2.5 and PM10), originating from vehicles, wildfires, dust, and oil and gas operations, among other sources. Erie has deployed air monitoring stations to track pollutants. Short- and long-term exposure to air pollutants can affect both human and environmental health. Erie also faces indoor air risks from radon, a naturally occurring carcinogen present in many Colorado homes.[5] Children, older adults, outdoor workers, and people with preexisting conditions like asthma are especially vulnerable to air pollution.[6]

Drought

Erie experienced major droughts in 2002 and 2012, prompting the development of tiered water restrictions and a Drought Management Plan.[7] Droughts reduce water availability, threaten agriculture, and can bring significant economic impacts. Indicators like the Palmer Drought Severity Index and Standardized Precipitation Evapotranspiration Index show Erie and Colorado as a whole trending toward drier conditions.[8] Vulnerable groups include the elderly, children, low-income households, and people with health conditions.[9]

Extreme Heat

Temperatures in Colorado have increased by 2.9°F since 1895, with projections showing Erie could face 20 to 83 days over 95°F annually by 2100.[10,11] Rising heat increases risk of heat illness, especially for those without air conditioning, outdoor workers, older adults, and people with chronic health conditions.[12] Erie is expected to see up to 10 heatwaves per year by the 2060s, an increase from one per year historically. A heat wave is a period of days in which the average temperature peaks above a threshold typically only exceeded once per year.[13]

Flooding

Erie's most significant floods occurred in 1890, 1921, and 2013.[14] The 2013 flood caused $4 billion in statewide damage.[15] A portion of Erie lies within FEMA Special Flood Hazard Areas (SFHAs), requiring flood insurance. In response, Erie partnered with the Mile High Flood District on mitigation projects such as the Coal Creek Expansion Project, improving drainage and levee systems. However, increased precipitation and impervious surfaces may elevate future risk.

Wildfires

Though not as prone to wildfires as other regions in Colorado, Erie has a medium wildfire risk, with 14% of buildings in direct exposure zones.[16] Wildfire smoke contributes to poor air quality and increases flood risk due to soil degradation.[17,18] Erie's wildfire vulnerability is mitigated by limited wildland-urban interface (WUI), though climate models project a 100 to 500% increase in burned area by 2050.[19] Vulnerable populations include the elderly, manufactured home residents, and people experiencing mobility issues.[20]

Social Vulnerability

Erie overall ranks low in social vulnerability, but disparities exist. Erie's population is 40,183 and is 83% white. The median income is $163,644, and 67% of the population has a bachelor's degree or higher.[21] Data from Headwaters Economics, the Climate and Economic Justice Screening Tool, and Enviroscreen 2.0 indicate that central Erie has greater vulnerability to climate and pollution-related risks compared to surrounding areas.[22] Erie currently has three manufactured home communities, which the State of Colorado counts as disproportionately impacted (DI) communities.[23,24]

Takeaways and Next Steps

Climate hazards in Erie are interconnected and are projected to increase in severity and frequency. Hazards affect public health and infrastructure, and they are especially impactful to vulnerable populations. The next major step is implementing the Resilience Action Plan, which outlines strategies for mitigating hazards, protecting vulnerable populations, improving emergency preparedness, and building long-term resilience.

Goals and Strategies

Infrastructure

Introduction

Resilient infrastructure is critical to the safety, economy, and well-being of residents. Building infrastructure that is able to withstand and operate during natural disasters will decrease the need for post-disaster rebuilding and ensure the continuation of essential services.

This chapter covers five topics: air quality, extreme temperatures, transportation, water management, and wildfires. The Town has a history of extreme weather events, such as the September 2013 flood and May 2023 hailstorm as well as the long-lasting regional impacts of the December 2021 Marshall Fire. These strategies focus on increasing resources to mitigate current and future hazards while also encouraging increased avenues to support Town residents.

Air Quality

Background

Particulate matter and ground-level ozone, among other pollutants, impact human health, especially in vulnerable populations like children, older adults, and people with preexisting medical conditions like asthma. Air monitoring, education, filtration, and elimination of pollutant sources all contribute to a reduction in exposure and improvement in air quality and health.

Current Town Progress
- In 2021, Erie received a Clean Air Champions Award from the Regional Air Quality Council (RAQC). The Town was recognized for its commitment to improving regional air quality and has been awarded Charge Ahead grant funds (in partnership with RAQC) to create a network of electric vehicle charging stations that are available to the public.
- The Town monitors air quality at five stations near oil and gas wells. These stations measure volatile organic compounds, particulate matter, and meteorological data. Erie hosts a Boulder Atmosphere Innovation Research (AIR) monitoring station at the Erie Community Center.
- The Town Sustainability Division offers radon mitigation system rebates and high efficiency particulate air (HEPA) purifier rebates.
- Erie residents are eligible to receive rebates for heat pumps, induction cooktops, electric lawn mowers, and other items that reduce impacts to air quality through the Sustainability Division's Energy Efficiency Rebate program.
  - The Energy Efficiency Rebate program was launched as a pilot in August 2023. That year, 44 participants received $16,534 in rebates during the initial five month period. In 2024, 258 participants received rebates totaling $27,550 during the first full year of the program. In 2025, as of July, there were $32,800 in rebates distributed among 209 participants. Grant funding from Boulder County has supported this rebate program to date.

Goals and Strategies
- Goal 1: Support the improvement of indoor air quality at home and in high-use areas such as the library and the community center.
    - Concept: Increasing air filtration during times when particulate matter and pollution is high can reduce exposure to pollutants and reduce impact to vulnerable populations.
    - Strategy 1: Educate homeowners and maintenance staff about options to create safe indoor air such as heat pumps and air purification systems.
    - Strategy 2: Continue to offer and expand Town Sustainability Division <u>rebates for heat pumps, air purifiers, and radon mitigation systems</u>. Explore the creation of income-qualified opportunities.
- Goal 2: Support the increased adoption of efficient, all-electric appliances including heat pumps and induction cooktops to eliminate the indoor combustion of fossil fuels and resulting air quality impacts.[25]
    - Concept: Benefits of efficient electric appliances and heat pumps include lower cooling costs and improved indoor air quality.
    - Strategy 1: Educate residents at tabling and educational events on the additional heat pump rebates available from local utilities and organizations.
    - Strategy 2: Continue to offer <u>Town efficient appliance incentives</u> for residents.
    - Strategy 3: Develop a healthy homes education event with local partners to support electric equipment adoption for residents.
- Goal 3: Reduce air pollution from outdoor power equipment and other common sources of outdoor air pollution.
    - Concept: Eliminating common sources of outdoor air pollution will reduce circulating pollutants and improve local air quality, especially on high ozone days.
    - Strategy 1: Continue to offer <u>Town Sustainability Division rebates for electric versions of common gas-powered equipment</u>.
    - Strategy 2: Consider expansion of Town rebates to include electric string trimmers, leaf blowers, and snowblowers.
    - Strategy 3: Continue to advocate for statewide air quality improvement via participation in programs such as the <u>Mow Down Pollution Program</u>.
    - Strategy 4: Explore replacing Independence Day fireworks with a drone show or other display that does not impact local air quality.
- Goal 4: Increase public awareness of outdoor air quality.
    - Concept: Continuing to monitor air pollutants and clearly communicating poor air quality events supports residents with understanding current conditions and reducing exposure.
    - Strategy 1: Educate residents about health impacts, available alert systems such as high ozone alerts from RAQC, and actions to take when measured air pollutants like particulate matter and ozone reach health-impacting thresholds.
    - Strategy 2: Continue to <u>maintain an air quality dashboard</u> and integrate data from new monitoring stations.

Extreme Temperatures

Background
Average annual temperatures and the frequency of sustained periods of unusually hot weather are on the rise. With this trend projected to continue, residents can benefit from home weatherization and access to temperature-controlled public spaces. Town-wide efforts to increase the urban tree canopy can provide additional refuge through the shade, air filtration, and cooling that trees provide.

Current Town Progress
- According to the Boulder County Urban Tree Canopy Assessment, Erie's urban tree canopy is 4% of the total land area. This assessment identified 7,313 acres within Erie that could be suitable for tree planting.
- The Erie Tree Planting Programs, funded by the Tree Impact Fund, include an annual residential tree rebate, a homeowners association (HOA) cost share, and a school and nonprofit cost share.
- The Town has an approved tree species list to ensure diversity and resilience in Erie's urban tree canopy.
- The Erie Tree Advisory Board educates residents about the importance of trees, maintains Erie's Tree City USA certification, and promotes and co-organizes the annual Arbor and Earth Day event. They also work with schools to educate students from first through third grade about the importance of trees, and they plant tree seeds with the students so that the students can plant trees at home.
- Erie has adopted the 2021 International Energy Conservation Code (IECC) standard, with adopted amendments. The Town requires solar-ready roofs in residential building code and offers solar photovoltaics (PV) and battery back-up incentives.

Goals and Strategies
- Goal 1: Gather hyperlocal heat data to better understand Town trends.
  - Concept: Collect and document additional data that shows neighborhood heat trends. This data will help staff and residents prioritize the areas of Town that will most benefit from targeted heat resilience efforts.
  - Strategy 1: Facilitate a Town heat mapping event, similar to the event led by the National Oceanic and Atmospheric Administration (NOAA) in Boulder in 2022. This information can guide future action and focus areas for heat reduction activities where most needed. It can also provide an opportunity for resident education and engagement.
- Goal 2: Improve residential building efficiency.
  - Concept: Improved efficiency can reduce heating and cooling costs and improve comfort during extreme temperatures.
  - Strategy 1: Continue to offer Town Sustainability Division home energy efficiency rebates.
  - Strategy 2: Continue to update Erie building codes in line with the International Energy Conservation Code (IECC) standards and strengthen amendments where appropriate.

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- Goal 3: Expand and support Erie's tree canopy with a diverse and resilient set of species appropriate to the region.
  - Concept: An expanded tree canopy will reduce ambient air temperature, increase shade and cooling, filter air pollution, and slow stormwater runoff, among other co-benefits.
  - Strategy 1: Continue to <u>incentivize tree planting</u> by individual homeowners, HOAs, schools, and nonprofit organizations.
  - Strategy 2: Offer saplings and plants at a fall community event such as Erie Fest to encourage fall planting. This would be complementary to the annual Arbor and Earth Day event that takes place in the spring and provides trees for participants.
  - Strategy 3: Collaborate with Play Boulder to develop a <u>Tree Tenders volunteer program</u> similar to other communities in Boulder County. This collaboration could ensure viability and health of the trees given away at Town events.
  - Strategy 4: Educate and create Town website resources for property owners on proper structural pruning of street trees to ensure long-term tree survival.
  - Strategy 5: Prepare an Urban Forestry Strategic Plan to identify and share the actions Erie will pursue to achieve its urban canopy goals.
  - Strategy 6: Consider an income-based tree canopy water rebate to support residents with watering new or already established larger trees throughout Town, as new and larger trees require significantly more water during times of drought.
- Goal 4: Explore a cool or green roof project on Town property.
  - Concept: Cool and green roof treatments can reduce local heating effects and building energy costs. Green roofs absorb stormwater to reduce local runoff and can support local pollinator populations.
  - Strategy 1: Consider the possibility of a cool or green roof treatment on a Town-owned building to serve as a demonstration project.
- Goal 5: Increase adoption of solar PV energy generation and associated battery backup systems.
  - Concept: Increased local solar generation reduces the strain on transmission lines, reduces emissions from peaker plants, and could provide energy during utility disruptions.
  - Strategy 1: Continue to incentivize <u>local PV solar energy rebates</u> and associated battery backup adoption.
  - Strategy 2: Continue to incorporate solar panels into Town-owned facilities where appropriate.
  - Strategy 3: Continue to explore community solar garden opportunities for Erie residents, whether Erie-based or somewhere else in Colorado.

Partnership Opportunities
  - Strategy 1: Work with <u>Energy Outreach Colorado</u> to explore income-based programs to offset higher winter heating costs for heat pumps and to support other home efficiency efforts.
  - Strategy 2: Continue to educate homeowners in Boulder County about standard and <u>income-qualified rebates through EnergySmart</u> for home retrofits.

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- Strategy 3: Continue to collaborate and communicate with outside organizations such as Xcel's Home Energy Squad program for efficiency audits and actions such as insulation installation and window replacement. This could be an expansion of the existing block grant program.
- Strategy 4: Employ local youth via the Community Forestry Corps for assistance with tree care and watering.
- Strategy 5: Partner with a local building owner to pilot a green or cool roof project. Gather data and share progress via the Town website and newsletters, and offer public tours to increase education.

Transportation

Background
96% of Erie residents that work commute to their jobs site outside of the Town. This can place a large burden on individual household spending through the ownership and maintenance of personal vehicles.[26] The Town of Erie's Transportation Division is focused on increasing the safety and effectiveness of all transportation methods through the 2024 Transportation Mobility Plan (TMP). Emphasis is placed on improving access to walking and cycling in the effort to improve air quality and well-being, traffic congestion, and emergency vehicle response times.

Current Town Progress
- The TMP is aligned with the 2019 Sustainability Action Plan. The TMP's capital investment strategy and implementation plan aims to reduce single occupancy vehicle travel to 58% of the transportation mode-share by 2025.
- The Transportation Division created a traffic operations model simulating the impacts of constrained corridors that surround the Town as well as the impacts of congested Colorado Department of Transportation (CDOT) highways on all four sides of Erie.
- The Town has a 2008 anti-idling ordinance that applies to Town vehicles.
- The Transportation Division has a Neighborhood Speed Management Program that aims to incorporate resident feedback to reduce speeding and promote walking and biking.
- The Town continues to improve physical street quality through the Safe Streets For All Federal Grant, Weld County Safety Action Plan, I-25 improvement projects, and others.
- The Town of Erie currently has 20 miles of on-street walking paths and 77 miles of off-street walking paths.
- The Town Sustainability Division offers e-bike incentives, which are stackable with the state e-bike tax credit. Research was conducted by the Transportation Division to understand the efficacy of an e-bike share program.
- The Town of Erie was a part of the Northwest Regional Bike Share Feasibility Study to inquire if a bike share program was going to be beneficial for the community.
- In 2025, Erie received the Charging Smart Bronze Designation award from the Interstate Renewable Energy Council for its electric vehicle (EV) policies and adoption efforts. These are

supported by the municipal fleet electrification procurement policy and incentives from Town of Erie Energy Efficiency Rebates for at-home EV chargers. There are additional incentives from the Xcel Energy EV Charger and Wiring Rebate and United Power EV Rebates.

- Regional Transportation District (RTD) bus access has increased to 15 bus stops in Erie through the JUMP bus route.
- Erie continues to strategically expand EV charging infrastructure. Erie will reach 35 public chargers by the end of 2025.
- A Boulder to Erie bike path is being developed to provide Erie and Boulder residents with a safe bike path as a method of transportation and recreation.
- RTD JUMP Bus Route Extension Plan Phase 1 and 2 is planned to extend into Weld County.
- The Transportation Division is developing traffic signal timing plans to support the risk analysis from emergency responders.

Goals and Strategies
- Goal 1: Support increased safety for pedestrians and cyclists that incentivizes cycling, walking, and multi-modal transportation for all age groups.
  - Concept: Ensure Erie residents have access to walkable and bikeable routes. These routes will also provide pedestrians and cyclists with increased safety in their travels.
  - Strategy 1: Educate residents on the importance of safety lights and reflective clothing in low light conditions.
  - Strategy 2: Work with vendors to pilot a shared mobility program with e-bikes and/or scooters to create additional emissions-free mobility options.
  - Strategy 3: Continue to increase bike parking and anti-theft infrastructure.
    - Expand bike garages for efficient land use while increasing parking opportunities and decreasing the opportunity for bike theft. For instance, the City of Fort Collins provides secure downtown bicycle parking.
    - Use BikeRackMap.com to support best practices with bike parking. Offer Economic Development Department and Environmental Services Department incentives to private businesses to upgrade bike parking facilities to encourage biking.
    - Offer Town of Erie Economic Development Department and Environmental Services Department incentives to build mobility hubs that include covered solar parking for e-bikes and EVs at shared parking locations such as shopping centers.
  - Strategy 4: Work with vendors to provide a small fleet of e-bikes that can be checked out at the library or community center, or provide passes for bike share access at the Erie Community Library. Educate users on proper storage and charging practices to maximize safety and lifespan of the e-bikes.
    - For example, the Telluride Townies program allows residents and visitors to check out a bike for up to four days, and Boulder BCycle provides fobs that can be checked out from Boulder libraries.
  - Strategy 5: Build raised sidewalks and bike paths, and incorporate physical barriers that are compatible with snow plowing and maintenance operations. By providing a physical barrier between pedestrians, bikes, and cars on the road, collision likelihood is decreased.

- Strategy 6: Explore the feasibility of reducing minimum parking requirements similar to the City of Boulder in their updated parking requirements in their <u>Access Management and Parking Strategy Code and Policy Updates.</u>
- Goal 2: Improve bus stop quality and access.
    - Concept: Provide high quality bus stops to make travel by bus more comfortable, accessible, and safe.
    - Strategy 1: Prioritize new bus stop shelters with protection from extreme weather events such as heat, hail, snow, wind, and rain that include seating.
    - Strategy 2: Provide communication of nearest water refill stations at bus stops.
- Goal 3: Provide evacuation education and clear route signage for each major hazard in Erie. Review and update the TMP information related to emergency evacuation on an annual basis.
    - Concept: If an extreme weather event were to occur in Erie, it is important that people know where to go in times of crisis. Evacuation routes for wildfire and flooding require unique strategies.
    - Strategy 1: Provide emergency response educational presentations and climate preparedness classes at the Erie Community Center. Include partner agencies such as Mountain View Fire Protection District (MVFPD) and the Erie Police Department to help constituents understand the importance of Go Bags, emergency management operations, and available alert systems.
    - Strategy 2: Send emergency alerts with a link to a live updated evacuation route map for each type of major environmental hazard, such as floods, tornadoes, and wildfires.
    - Strategy 3: Deploy Variable Message Boards (VMBs) around Town that advise evacuation routes.
    - Strategy 4: Use cameras and artificial intelligence (AI) tools to monitor emergency conditions and provide alerts to emergency responders proactively.

Partnership Opportunities
- Strategy 1: Continue to partner with <u>Transportation Assistance and Options non-profits</u> for transportation accessibility.
- Strategy 2: Develop bike and walking trains with local businesses and schools to build community and safety in numbers when commuting.
    - The <u>City of Boulder Safe Routes to School Program</u> and <u>El Monte Walking School Bus Program</u> in California are examples of increased transportation safety efforts.
- Strategy 3: Develop financial incentive programs with local businesses for non-car commutes to work.
    - The Google Boulder Campus incentive program provides increased salary for non-car commuters.[27]
- Strategy 4: Continue to invite local bike shops to Town events so that residents can learn about available incentives and mobility options such as bicycles and e-bikes while supporting the local economy.

Water Conservation and Stormwater Management

Background
To ensure residents have access to safe, clean drinking water, the Town has developed several measures to improve water quality, storage, and usage. In 2021, the Town of Erie finalized the Water Efficiency Plan and the Drought And Water Supply Shortage Plan. This section of the plan works in partnership with these plans, as well as the water efficiency goals present in the 2025 Parks, Recreation, Open Space, and Trails Plan. These goals support previous efforts and further protect water resources against potential hazards such as droughts, floods, and pollution.

Current Town Progress
- The Town has increased efficiency with its water use, as seen in the overall decrease in Town water usage per capita per day. These impacts are the result of several Town programs such as the installation of smart water meters, tiered billing rates, water efficiency rebates, and the launch of the Sustainability Division Turf Replacement Rebate program in 2021.
- The Town's Stormwater Quality Program ensures compliance with the Colorado Department of Public Health and Environment (CDPHE) municipal separate storm sewer system (MS4) permit. This program provides materials to educate residents and businesses about protecting water quality, supports the investigation and remediation of illicit discharges, trains Town staff on ways to identify pollutants and reduce pollution while doing their daily job tasks, and ensures that new development meets design standards for providing water quality.
- The Town has created a stormwater maintenance division within the Utilities Department that inspects, maintains, and repairs stormwater infrastructure.
- Town of Erie's Floodplain Information website provides resources for understanding flood risk.
- After the flood in 2013, the Town of Erie has improved floodplain data, mapping, and tracking. The Federal Emergency Management Agency (FEMA), Boulder County, Weld County, and the Mile High Flood District (MHFD) collaborate to alert and prevent floods from causing death and destruction of infrastructure.[28]
- The Town of Erie design standards follow the Mile High Flood District Criteria Manual to include Permanent Control Measures that promote soil infiltration.
- Town of Erie ordinances for flood hazard reduction require floodplain development permits for construction in the FEMA Special Hazard Flood Area (SHFA).
- The Coal Creek Expansion project and the Erie Wetlands mitigate erosion, protect infrastructure, reduce flood risk, educate the public about wetland importance, and improve water quality.
- The Town holds commemorative events such as the Ten Years Later flood remembrance event which was held to educate people on flood risk and to honor those who lost their lives and homes.
- The Town is creating a waterwise landscaping ordinance to improve water usage in new developments. This ordinance will encourage use of vegetated swales.
- The Town is partnering with the Weld County Youth Conservation Corps to implement a Flush and Flow Program and install high-efficiency toilets in residential homes.

- The Coal Creek Channel Restoration and Flood Control project is upcoming. The project will realign Coal Creek to create a natural stream function, and County Line Bridge will be re-constructed. The result will be a functioning creek that removes several Erie and Weld County residents from the floodplain.

Vegetated Swale

Vegetated swales act as dry ponds with drains in the center to allow water to naturally pool in the area. Native flowers, grasses, and trees can also be planted to slow the speed at which the water is traveling and allows the water to infiltrate.

Image of how vegetated swales can be seamlessly integrated into urban design.[29]

Goals and Strategies

- Goal 1: Use education and advocacy strategies in programs and resources focusing on residential, industrial, and commercial water demands, specifically in the case of drought conditions.
  - Concept: The Town has several opportunities to support residents in improving their water usage. This goal continues to increase education and equitable access in this area. It is important to educate the public about the likelihood of drought in their community. Once residents understand the likelihood, the community then needs to know how to respond.
  - Strategy 1: Educate Town residents on rainwater storage regulations and best practices for their homes and connect them with the existing Town rain barrel rebate.
  - Strategy 2: Track water use in Town-owned properties and display the results on a public dashboard.
  - Strategy 3: Ensure government employees in charge of tracking and alerts are employed and adequately funded to conduct their duties and ensure emergency alerts for floods and drought conditions are timely and accurate.
- Goal 2: Integrate low impact development (LID) methods into all Town planning.
  - Concept: LID methods create a design process that upholds the ecosystems and water systems present in the environment of an area during development to protect or mimic its processes.[30] The systems of urban areas are often interconnected, and features within and near water systems can be altered to better support Town operations.
  - Strategy 1: Implement low impact development methods in new construction.
    - For example, the City of Edmond Resiliency Action Plan is currently working to expand their LID requirements for new construction and redevelopment.
  - Strategy 2: Explore installment of sump pumps in public buildings vulnerable to flooding.
  - Strategy 3: Create training opportunities for low impact development operation and maintenance strategies for the Town workforce.
- Goal 3: Retrofit public streets into green streets through reducing impervious and dark surfaces.
  - Concept: Streets are a key feature of urban areas and can be tailored to the needs of the community and environment to become multi use. Minimizing hard, dark surfaces such as asphalt reduces local heating and stormwater runoff.
  - Strategy 1: Create educational opportunities for Town residents to integrate features of green streets on their properties.
  - Strategy 2: Identify a pilot parking lot site for retrofitting. Consider replacing asphalt with permeable surfaces and lighter colored material, integrating green infrastructure for shading and stormwater filtration, increasing shading with elevated solar, or adding porous pavers similar to the University of Colorado Boulder Stormwater Management and Performance Goals (PDF).

- Strategy 3: Integrate rain gardens with native plants in vacant lots to improve stormwater control and provide water to the local soil and environments. Rain gardens are usually located near corners of sidewalks to improve pedestrian safety and comfort.
- Strategy 4: Review Town codes to determine where shading and porous surfaces can be incorporated, such as new parking lot construction, in a way that is compatible with snow plow and maintenance operations. Efforts can be combined with strategies from the Town ordinance for water wise landscapes.
- Strategy 5: Incorporate lighter colored road treatments where possible, such as cool pavement methods used by the City of Phoenix, Arizona.

Wildfires

Background
The Town works with several partners to decrease potential wildfire hazards during warm weather and dry conditions. The Parks and Recreation Department has implemented several methods that are nationally recognized to maintain the health of open space within Town limits. The aim of these strategies is to increase education and partnerships to continue improving the proactiveness of the Town to reduce wildfire impacts.

Current Town Progress
- The Town of Erie works with Wildfire Partners to improve wildfire mitigation for residents within Boulder County. These efforts include individual home assessments, a community chipping program, and rebates for mitigation strategies.
- The Town Recycling Center collects items that may act as wildfire fuels, such as yard waste.
- Weld County regulates open burning permits to mitigate potential wildfire risk.
- The Town provides resources for licensed arborists to begin the process of residential wildfire mitigation on resident properties.

Goals and Strategies
- Goal 1: Increase wildfire mitigation education and infrastructure strategies.
  - Concept: Several wildfire mitigation practices were identified by community leaders, and increasing access and implementation for these safety measures will better adapt the Town for future extreme weather events. For example, the Colorado Wildfire Resiliency Code Board developed changes to building codes to improve Colorado wildfire resilience.
  - Strategy 1: Hold seasonal workshops for Town residents to develop wildfire action plans for their residences and improve wildfire mitigation strategies in the area immediately surrounding and within their residences.
    - Additional resources are provided by Wildfire Partners' community advising, Cal Fire's Wildfire Action Plan website, the Communities Pathways Interactive Tool from the Fire Adapted Communities Learning Network, and safety awareness materials from the U.S. Fire Administration. Action plans also support Town residents in preparing for other extreme weather events.

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- Strategy 2: Work with HOAs to integrate a strategy for noncombustible siding material on buildings. Wildfire Partners recommends a minimum of six vertical inches of noncombustible siding material.
- Strategy 3: Work with Xcel Energy and United Power to continue to bury electrical lines and distribution lines for critical operations to reduce the likelihood of ignition and reduce power disruptions during extreme weather events. United Power has specific funding resources the Town can utilize to support these efforts.
- Strategy 4: Increase awareness for proper disposal of toxic and flammable chemicals and other materials, such as lithium batteries, as well as their connection to wildfire resilience for residents at Town events.

Partnership Opportunities
- Strategy 1: Partner with relevant organizations to provide emergency response educational lectures at the Erie Community Center.
- Strategy 2: Incentivize residential and agricultural collection of wood chips and plant debris for fertilizer or additional biochar applications with Biochar Now or the Town Recycling Center.
  - For instance, the City of Edmond Resiliency Action Plan is planning to apply urban wood utilization practices to provide fertilizer and improve overall land use and urban design.
- Strategy 3: Work with wildfire mitigation experts such as Wildfire Partners to expand individual home assessments for regions within the Town that currently do not have access to these types of programs.
  - Community Mitigation Assistance Teams, Community Planning Assistance for Wildfire, the Fire Adapted Communities Learning Network, and the Wildfire Resiliency Code Board may provide further resources.
- Strategy 4: Explore the option of prescribed burning and regular brush management for grasslands where appropriate for fuels and ecosystem goals.
  - The Colorado Division of Fire Prevention and Control has resources for prescribed burning and a Certified Burner Program for private land. The Florida Department of Agriculture and Consumer Services also has resources for prescribed burning.

Land Management

Introduction
The planning area for Erie spans 48 square miles, of which 21 miles are incorporated. The Town boasts 1,500 acres of open space, including 285 acres of agricultural land. A common bond between both public and private lands is that they contribute to local biodiversity, stormwater management, and air and water filtration. Plants within this area also keep temperatures cool, provide shade, and create habitats for pollinators and other wildlife. Additionally, low water use and firewise landscaping practices contribute to greater water conservation and wildfire risk reduction. Open space and mountain vistas are an integral part to quality of life in Erie, and the Town has 70 miles of trails that support a healthy and active population and culture.

Areas of focus within this chapter include agriculture, landscaping, parks, and open space. Each focus area contains overarching goals supported by adaptive strategies. This chapter also includes partnership opportunities that further enhance Town-led efforts.

Agriculture

Background
The agriculture sector of Erie holds economic, ecologic, and historical significance. For over a century, local agriculture operations have supported the community with staple crops such as corn, alfalfa, wheat, and sugar beets, as well as livestock and dairy production. Agricultural lands in and around Erie's borders play a significant role in resilience as the Town continues to expand in population and urban development. Preserving agricultural land, promoting local food systems, supporting soil quality, conserving water, and enabling adaptive practices are essential components of building long-term community and environmental health.

Current Town Progress
- The Town of Erie currently manages 285 acres of agricultural land. The Agricultural Land Lease Program allows private landowners to lease Town-owned property for agricultural use.
- The Erie Farmers Market provides a place for farmers to sell Colorado-grown produce and goods directly to locals and visitors.
- The Town of Erie partnered with Community Fruit Rescue in 2025 to reduce food waste and increase access to local fruit.
- Redevelopment of the Schofield Farm property includes new event space and will soon provide an Erie Makerspace and classrooms for rent.

Goals and Strategies
- Goal 1: Consider creating a designated Sustainable Agriculture Plan for Erie.
  - Concept: It is important to develop a central hub of information including best practices and sustainable applications as agricultural operations continue to evolve. This plan is an opportunity for agriculture workers, scientists, and government officials to work together to solve complex environmental and economic problems.
  - Strategy 1: Review and consider combining aspects of multiple State of Colorado, Town of Erie, Boulder County, and Weld County plans to inform the first Town of Erie Sustainable Agriculture Plan. The information would build on local resources such as Boulder County's agriculture management resources, Weld County's Right to Farm Statement, Colorado State University's sustainable agriculture resources, and the Colorado Environmental Agriculture Program.
  - Strategy 2: Describe financial and environmental benefits of sustainable agriculture such as rotational animal grazing, reducing reliance on artificial fertilizers and pesticides, using cover crops to improve soil health, and others.
- Goal 2: Increase economic opportunities for small scale agriculture operations.
  - Concept: Increasing the economic opportunities for small agriculture operations ensures economic viability and survivability of their operations.
  - Strategy 1: Explore the interest in expanding access to local produce by partnering with the Erie Farmers Market or other partners to create a local food market similar to a community supported agriculture (CSA) model.
  - Strategy 2: Build agrivoltaics legislation into the next Erie Unified Development Code update. Agrivoltaics provides agricultural land owners with additional income from solar energy generation on cropland and grazing land.
  - Strategy 3: Continue to provide business plan assistance through the Economic Development Council. This could include planning tips for the business side of agriculture such as contracting with distributors, integrating event space, operating tours, and hosting field trips.
  - Strategy 4: Engage and promote current and future farm-to-table restaurants to expand local food distribution.

Partnership Opportunities
  - Strategy 1: Advocate for sustainable agriculture lessons in K-12 classrooms through in-school presentations.
    - High school students could develop a project that would involve coming to elementary and middle schools to talk to younger students about the agriculture programs that Erie has such as the Mountain Vista High School Agriculture Curriculum and Erie High School Agricultural Sciences Program.
  - Strategy 2: Encourage private agricultural land owners to partner with the non-profits such as MAD Agriculture and Frontline Farming for education on sustainable agriculture and regenerative agriculture practices.

- Strategy 3: Explore partnerships that would provide incentives for agricultural practices to transition to drought-tolerant crops and technologies, such as agrivoltaics.
- Strategy 4: Partner with the Farmers of America Mentorship Program for new farmers and students.

> **Agrivoltaics**
>
> Agrivoltaics is a system where agricultural (crops or livestock) and solar energy production are taking place on the same piece of land. This creates a dual use parcel of land to maximize profits and improve environmental quality. Solar panels are a renewable energy source, and at the same time these solar panels provide shade to the soil and animals below. The shade provides a safer and more comfortable habitat for the livestock and prevents excess evaporation from the irrigated crops. Jack's Solar Garden is a local example of agrivoltaics in Longmont, Colorado.

Image of Jack's Solar Garden agrivoltaics system in Longmont, Colorado.[31]

Landscaping, Parks, and Open Space

Background
Erie's parks and open spaces provide endless opportunities for community events, recreation, and scenic vistas. These amenities include hundreds of acres of protected land that deliver services such as stormwater retention and filtration, habitats for wildlife, and areas for native trees, plants, and grasses to thrive.

Current Town Progress
- According to the 2025 Town of Erie Community Profile, Erie boasts 1,500 acres of parks and open space and 70 miles of trails. 99% of residents have access to at least one park within one mile of their home.
- Erie continues to improve irrigation efficiency in Town parks, as outlined in the Parks, Recreation, Open Space, and Trails Plan and Water Efficiency Plan. Strategies have included the installation of smart irrigation controls and moisture sensors at Town parks, irrigating during times where evaporative loss is minimal, and maximizing reuse water for irrigation purposes.
- The Town Sustainability Division facilitates an array of rebates that incentivize residents to reduce outdoor water usage and integrate low water use landscaping. Since 2022, the Turf Replacement Rebate Program has provided $269,510 to support the removal of approximately 206,127 square feet of turf. Additionally, 200 participants have received more than $40,000 through water efficiency rebates.
- The Sustainability Division supports volunteers in the Adopt-a-Road program to help maintain open spaces near roads.
- Resource Central, a local nonprofit, has supported outdoor water conservation via the Lawn Replacement, Garden in a Box, and Slow the Flow programs in Erie since 2004.
- Town efforts are bolstered by Colorado Senate Bill 23-178, which prevents HOAs from requiring residents to maintain water-intensive turf grass.
- The Open Space Management Plan contains a list of plant species that can harm native species.
- Parks and Open Space Staff prune all Town property trees on a four year cycle to ensure tree health, removing potential wildfire ladder fuels in the process.
- The Town of Erie floating solar project will be 1.2 megawatts in size and is being installed at the North Water Reclamation Facility.
- Pollinator habitats have been prioritized in recent years.
  - Pollinator habitat exhibits and water wise landscaping can be seen throughout town. These exhibits include the Erie Town Hall front lawn, Thomas Reservoir, and Erie Community Park.
  - The Sustainability Advisory Board sponsored and passed Erie's first Pollinator Proclamation in June, 2025.
  - Erie's Buzzing Gardens Mapping Program is a "map showcasing public pollinator habitats and pollinator friendly gardens planted by Erie residents."

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- Friends of Coal Creek Pollinator District Program is a map that highlights native pollinator gardens in towns connected to Coal Creek.
- Resource Central's Garden In-a-Box Program sells a variety of affordable native plant kits to support healthy residential ecosystems that are very popular with residents. The Town subsidizes the cost of these kits for residents.
- Erie's Sustainability Advisory Board hosts pollinator-focused events such as National Pollinator Week
- There are native bee house workshops from the High Plains Library District.
- Erie is in the process of becoming a Butterfly Pavilion Certified Pollinator District.

Why are pollinator species important?

As towns and cities expand, there is less native habitat for species to survive. Pollinators are keystone species, which means without a sufficient population of pollinator species such as birds, bees, butterflies, beetles, and bats, the biodiversity and health of ecosystems diminishes. Pollinators play a significant role in ecosystem health and the overall food supply, as these animals are responsible for 35% of all food production globally.[32] Pollinator species are responsible for the reproduction of many fruits, vegetables, and nuts. These crops play a massive role in the economy of Colorado, the United States, and the rest of the world.

Bees pollinating an apple crop.[33]

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Goals and Strategies
- Goal 1: Increase public volunteer and educational opportunities.
  - Concept: Volunteer opportunities provide forums for educational messaging, increase community land stewardship, strengthen community bonds, and provide additional human resources to supplement staff efforts.
  - Strategy 1: Develop and support Town-led volunteer events at parks to perform nature restoration such as weed removal, streambank restoration, and trash cleanups.
    - Resources and support can be acquired from community partners such as projects led by Wildlands Restoration Volunteers and volunteer opportunities from Boulder Open Space and Mountain Parks.
  - Strategy 2: Create an advertising campaign for residents on plants, insects, and other species that can cause harm to native species.
    - The public awareness campaigns resources from the United States Department of Agriculture (USDA) and the North American Invasive Species Management Association's awareness campaign provide various resources for campaigns and general outreach to the public. The California Department of Fish and Wildlife also has a week-long awareness event that provides further examples.
  - Strategy 3: Provide Town resources or create an awareness campaign for residents to reduce wildlife conflicts.
    - The Town can join a committee in the Habitat Partnership Program for more resources and support. Jeffco Open Space provides a platform for park visitors to report interactions with local wildlife.
- Goal 2: Continue to minimize non-functional turf grass.
  - Concept: Removal of nonessential turf grass reduces outdoor water use.
  - Strategy 1: Pilot low-water grass in place of Kentucky Bluegrass in a park, and add signage for public education.
    - The City of Lafayette recently carried out its own low-water pilot project. Examples of low-water grasses include Tall Fescue, Sheep, Blue, and Hard Fine Fescues, Tahoma 31 Bermuda Grass, Texas Hybrid Bluegrass, and Dog Tuff Grass, among others, per the Town Turf Replacement Rebate Program.
  - Strategy 2: Conduct an assessment of Town properties to determine coverage by non-functional turf and noxious weeds. Prioritize replacement with low-water, drought-tolerant, fire-adapted, and pollinator-friendly native plants.
  - Strategy 3: Continue to provide incentives for residential turf replacement. Explore ways to increase resources for conversion projects for residents and businesses, including regular educational events.
- Goal 3: Perform strategic wildfire fuels mitigation in open spaces.
  - Concept: Continue to selectively reduce fuels in parks and open space to reduce risk to natural resources, infrastructure, and adjoining properties as well as to reduce cost to rebuild and retrofit damaged infrastructure.

- ○ Strategy 1: Inform residents of more extensive fire mitigation strategies, such as prescribed burning and fuel breaks, before they are implemented, at Town events and on the Town website.
    - The Colorado Department of Public Health and Environment's website for community outreach on prescribed fires and the Fire Adapted Communities Network's lessons learned for prescribed fires provide resources for this strategy.
- ○ Strategy 2: Continue to perform strategic mowing along property boundaries, in proximity to buildings, and where fuel breaks can reduce likelihood of fire spread and provide safe areas for firefighters to conduct their work.
    - Examples of fuel breaks are present within Northern Colorado Fireshed Collaborative's prescribed fire projects and Summit County's fuel breaks.
- ○ Strategy 3: Use fire-adapted landscaping principles near Town buildings, such as spacing plants appropriately, avoiding flammable species, and maintaining defensible space.

Partnership Opportunities
- ○ Strategy 1: Staff continue to support the efforts of the Sustainability Advisory Board and local nonprofits such as Friends of Coal Creek for pollinator and low-water garden tours and firewise landscaping workshops.
- ○ Strategy 2: Continue to explore a collaboration, including funding the Arbor Day Foundation, to provide additional trees for residents.
- ○ Strategy 3: Review the state of natural surface trails and identify potential barriers to accessibility by working with local partners, such as Monarca Group.
- ○ Strategy 4: Connect residents with seed libraries of native plants that have low flammability and are water efficient.
    - The Boulder Public Library's Seed Library is a potential partner, and the Jefferson County Extension Seed Library in Washington provides a model for future seed libraries.
- ○ Strategy 5: Increase connections with HOAs to promote pollinator habitats. Homeowners can also learn how to create native pollinator habitats through Friends of Coal Creek garden assessments, a "leave the leaves" campaign, and reduction of pesticide use.
- ○ Strategy 6: Expand education and efforts to become a DarkSky Certified Town to reduce artificial lighting and disruptions to pollinator species' circadian rhythms.
- ○ Strategy 7: Integrate indigenous perspectives from local and regional partners in Town conservation efforts.
    - Resources are provided by Right Relationship Boulder, the Tribal Consultations website from the City of Boulder, the Denver American Indian Commission, and the Colorado Commission of Indian Affairs. CU Boulder's previous conservation workshop that may serve as a model for future actions.

What is a pollinator habitat?
A pollinator habitat has three different blooming native plants for each season (three in the spring, three in the summer, and three in the fall).

Erie Community Park has a Native Pollinator Garden within it.[34]

People can create pollinator habitats in their own backyard
with bee houses and native plants.[35]

Community

Introduction

A stable community ensures that all people are given the opportunity to succeed through responsibility, safety, connectedness, opportunity, and health. This chapter provides information on the key components of accessibility, economic development, healthy lifestyles, the creation of a resilience hub network, and youth empowerment. This chapter also includes partnership opportunities that further enhance Town-led community building and engagement efforts. Building a well-rounded community takes persistent time, effort, and commitment. As a result of such efforts, the residents of Erie can continue to be proud of the place they call home.

Accessibility

Background
Accessibility ensures that all residents, regardless of age, ability, or background, can easily engage with their environment, explore educational opportunities, and have fulfilling experiences. While this includes compliance with the Americans with Disabilities Act (ADA), Town resources strive to go further with supportive and effective methods that improve overall quality of life.

Current Town Progress
- The Town of Erie Risk Management Division has various responsibilities, including managing the Town Safety Program as well as issues concerning physical compliance with the Americans with Disabilities Act (ADA).
- The Town Communications Team ensures the Town website complies with guidelines from the Web Accessibility Initiative and has a grievance procedure for ADA complaints. The Town Statement of Accessibility is also published online.
- The Erie Police Department has staff available to assist residents in accommodations to access Erie police services.
- The Town is updating their ADA Self-Evaluation and Transition Plan, which includes ADA self-evaluations being conducted on public right-of-ways within Erie.

Goals and Strategies
- Goal 1: Increase accessibility by expanding related learning opportunities within the local community.
    - Concept: As the age of Town residents advances, and to mitigate social vulnerabilities, increased resources and events focused on accessibility can improve the awareness, connectivity, and preparedness of the local community.
    - Strategy 1: Increase outreach and learning opportunities during Town events for accessibility support and resources, such as service animals, culture within the disability community, and ADA resources.

- Resources are available on the <u>United States Primer for State and Local Governments</u> and <u>University of California San Francisco's overview of disability culture and identity</u>.
- <u>DisabilityResources.org's list of Colorado disability services</u> and the <u>Colorado Programs for Individuals with Physical or Developmental Disabilities</u> also provide other methods of support.
  - Strategy 2: Advertise Erie Community Library resources and <u>Erie Uplink resources</u> during Town events, such as <u>Experience Passes</u>, basic need resources, guides for parents, tax information, and more.
  - Strategy 3: Establish partnerships to support regular training sessions on conflict de-escalation and accessibility for local government staff and local law enforcement.
    - <u>Colorado Circles for Change</u>, <u>Conflict Transformation Works</u>, <u>Right to Be</u>, <u>The Circles Project</u>, and the <u>National Conflict Resolution Center</u> have resources to build upon these workshops.
  - Strategy 4: Continue to research methods and expand resources for translating Town and other important documents into different languages or providing translation services.
  - Strategy 5: Continue to explore expanding access to free public WiFi with potential partners, such as Allo.
    - For instance, the <u>City of Boulder Connect Boulder initiative</u> and <u>Pearl Street's free WiFi partnerships</u> may provide guidance.
  - Strategy 6: Look into joining the <u>Government Alliance on Race and Equity</u> (GARE) network to acquire resources to better support the community.
- Goal 2: Support increased access to community engagement and services for people with disabilities.
  - Concept: As the Town grows, continued assistance for support systems ensures all residents can meet their needs as locally as possible.
  - Strategy 1: Establish a Vocational Rehabilitation Process for Town residents with disabilities.
    - For example, the <u>Delaware Vocational Rehabilitation Process</u> has resources for creating this process and supporting participants.
  - Strategy 2: Create partnerships to increase funding and resources for Town residents seeking specialty care.
    - The <u>Colorado Health Assistance Programs</u> also provide various avenues for support.

Partnership Opportunities
  - Strategy 1: Work with the Erie Community Library to advertise and expand language workshops for residents learning English as a second language, as well as for English speakers to learn regional languages such as Spanish, Nepali, Arapaho, and American Sign Language.
  - Strategy 2: Work with Being Better Neighbors and the P.L.A.Y. Education Corporation to integrate opportunities for individuals with disabilities as well as youth training opportunities for cultural humility and social inclusion into Town events.
  - Strategy 3: Continue to expand potential partnerships with other local community organizations to improve connection within the Town.

Economic Development

Background
Economic development plays a critical role in building long-term community resilience by supporting diverse industries and ensuring inclusive access to opportunity. By continuing to expand existing efforts that support small businesses, invest in workforce development, and encourage innovation, Erie can continue to create an economic foundation that can withstand disruptions and adapt to change while ensuring that prosperity is shared equitably across the community.

Current Town Progress
- Erie has a bilingual Small Business Development Center counselor available to provide free guidance to local entrepreneurs.
- The Town offers business incentive programs such as the Old Town Revitalization Grants, tax increment financing funds, and a Construction Mitigation Grant Program.
- The Economic Development Department and the Sustainability Division recognize sustainable businesses via Colorado Green Business Network of Erie recognition.
- The Town website provides a thorough list of available resources to help prospective entrepreneurs start their businesses.
- The Erie Chamber of Commerce has a local business membership program that provides local business support through advertising and access to Town events.

Goals and Strategies
- Goal 1: Provide Erie businesses and residents with the ideas, tools, and finances to become more inclusive, environmentally responsible, and resilient.
  - Concept: This goal can aid the Town by ensuring the economy flourishes well into the future by basing values in social equity, infrastructure efficiency, and expanded market reach.
  - Strategy 1: Explore providing resources for businesses to conduct racial equity analyses such as Allyship at Work and Equity In The Center.
  - Strategy 2: Continue work on establishing a plan to support a Black, Indigenous, and People of Color (BIPOC) marketplace.
  - Strategy 3: Continue to support and expand sustainability-related workshops for businesses to learn how they can improve efficiency and lower costs through Town rebates and other initiatives.

Partnership Opportunities
  - Strategy 1: Partner with the non-profit United States Green Building Council (USGBC) and other community based organizations to provide support, technical assistance, and training for local businesses to learn about sustainability certifications for buildings and operations such as the Leadership in Energy and Environmental Design (LEED) certification.

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Healthy Living

Background
An equal opportunity to live a healthy lifestyle is a key part in building a thriving community. This includes access to clean air and water, opportunities for physical activity, healthy food options, and support for mental and emotional well-being. Encouraging healthy lifestyles provides education, access, and opportunities for the prevention of common chronic health conditions. When people in a community are healthy, they are better able to adapt to change, recover from challenges, and support one another. As the Town continues to grow, it is crucial that health and wellness are considered in local decisions.

Current Town Progress
- The Town of Erie offers many Specialty Fitness and Wellness Programs.
- Unique recreational fitness opportunities in Erie include the Erie Singletrack Trails at Sunset Open Space, Boulder Valley Velodrome, and Erie Revolution Pumptrack.
- Senior Citizen fitness opportunities in Town include the Tivity Health SilverSneakers Fitness Program, Silver and Fit Program, and both indoor and outdoor pickleball courts.
- Erie celebrates National Family Health and Fitness Day.
- The Town provides Erie Community Resources (PDF) for mental health and other services.
- Erie Community Food Bank currently provides food assistance services to roughly 300 residents monthly.
- Visitors to Serene Park have access to public outdoor gym equipment.
- Boulder County provides free Healthy Home inspections for radon.
- Weld County provides free short-term test kits for radon.
- The Town of Erie Air Quality Monitoring Program provides residents with access to air quality education and mapped data collection.
- The 2025 Town of Erie Drinking Water Quality Report (PDF) showed no contamination above unsafe and legal thresholds for all potential contaminants.
- There are many measures the Front Range Landfill takes to ensure compliance with local, state, and federal laws. The landfill has multiple levels of protection to prevent environmental contamination.
- The Town provides guidance on staying safe from stormwater and waterway contamination through Coal Creek recreation recommendations.
- The Oil and Gas Unified Development Code (Chapter 12) aims to improve communication and health standards of oil and gas companies in an effort to protect the people that live and work near development sites.

Goals and Strategies
- Goal 1: Reduce potential exposure to contamination from oil and gas operations in and around the Town of Erie.
    - Concept: Oil, gas, and decommissioned mining sites are within Erie and surrounding areas. It is important to educate people on their possible exposure to environmental contaminants from these operations.

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- Strategy 1: Ensure full transparency chemical-use disclosure from the oil and natural gas industries. This can be done by providing homeowners near fracking sites with a list of written legislation and potential exposure levels to chemicals.
  - State resources:
    - Oversight Of Chemicals Used In Oil and Gas (PDF)
    - Colorado Chemical Disclosures website
  - Federal resources:
    - Resource Conservation and Recovery Act
    - Comprehensive Environmental Response
    - Compensation, and Liability Act
    - Emergency Planning and Community Right-to-Know Act

Partnership Opportunities
- Strategy 1: Increase access to community gardens through collaboration with HOAs, specific neighborhoods, and organizations such as Denver Urban Gardens (DUG).
  - DUG provides resources on how to build a community garden and education on the benefits of a community garden.

Resilience Hubs

Background
Resilience hubs are community assets that provide services during regular operations (blue sky days) and during emergencies and recovery efforts. They can be located within government buildings or at the facilities of trusted community partners. With the appropriate infrastructure, preparation, and coordination, resilience hubs can support the community during times of crisis. Common services provided at hubs include climate-controlled building access during extreme temperatures, backup power during utility disruption, poor air quality relief, reliable communications, and distribution of necessary resources.

Current Town Progress
- Erie does not currently have a holistic resilience hub, though it does have many nonprofit, religious, and community organizations that could support the creation of a resilience hub network. Additionally, the Erie Community Center provides a climate-controlled lobby with bathroom access to the public.

Goals and Strategies
- Goal 1: Explore potential resilience hub location(s) and network.
  - Concept: Resilience hubs provide access to critical resources during emergencies and a range of services during normal operations.
  - Strategy 1: Research and potentially establish Erie's first resilience hub at the Erie Community Center.
  - Strategy 2: Continue research and outreach to determine trusted community partners for hub network buildout and to identify needed resources such as refrigeration and device charging. Explore future community engagement opportunities.

- ○ Strategy 3: Create a roadmap for community partners to become a part of the network. Identify Town staff who can support the creation of this document and guide partners toward participation and certification.
- ○ Strategy 4: Consider piloting expanded rebate and grant programs for partners in alignment with resilience hub needs. Examples of where to focus resource support could include battery backup systems, onsite solar generation, air filtration, and building efficiency.
- ○ Strategy 5: Work with the local transit provider to create an emergency operations plan to ensure residents have transportation to the hub(s) and needed mobility solutions.
  - ▪ The underlined upcoming Flex Ride service could play a role in this plan.
- ○ Strategy 6: Create a page on the Town website to share resources for extreme temperatures. Include temperature-controlled locations open to the public, water access locations such as splash pads and pools, and educational materials about avoiding and recognizing heat illness.

Partnership Opportunities
- ○ Strategy 1: Create a tool library and provide access to Erie residents. The tool library could be incorporated into the planned CO-Create Erie Makerspace or into Erie Community Library operations. Examples of tool libraries in the Front Range include the Denver Tool Lending Library, Fort Collins Tool Lending Library, and Longmont's Library of Things.
  - ▪ Registering as a Repair Cafe can provide an opportunity for tool funding.

Youth Engagement and Empowerment

Background
Providing pathways for young individuals to become leaders in their communities fosters a new generation of active community members, thus placing a municipality at the forefront of innovation for the future. Children can struggle with identity, sense of belonging, and fair representation. By expanding opportunities and mentorships for youth, the Town of Erie can ease the transition from childhood to adulthood and allow for young people to have a larger voice in local decision making. Through this effort, youth today will become the mentors and positive role models for the next generation of Erie residents.

Current Town Progress
- Erie Youth for Change recruits students in seventh through twelfth grade to work on issues, projects, and programs with the Town of Erie and other local organizations.
- The Town of Erie Sustainability Advisory Board and Tree Advisory Board both have positions for a youth member.
- The Weld County Junior Fair Board chooses members from the ages of 14 to 18 years to work on outreach and support the Weld County Fair.
- The Erie Community Library provides various events focusing on different age groups, ranging from infants to high school students.

- The Erie Community Center provides various summer programs and events for children of all ages and is establishing the Community Connections program, with events such as Community Game Night and Connection through Creative Expression.
- The Weld Community Foundation Scholarship program supports students in funding their college education.
- The Weld County Youth Conservation Corps engages youth and young adults from the ages of 16 to 30 years in meaningful community and conservation service projects.

Goals and Strategies
- Goal 1: Increase opportunities and resources for youth engagement to improve connection within the community.
    - Concept: By providing focused events for young people, the Town can promote community connectedness, security, and growth.
    - Strategy 1: Provide mentorship, networking, and shadowing opportunities for youth in different Town departments and organizations to support future employment in growing industries that will improve Town resilience.
        - Additional support resources can be identified through the Erie Youth for Change and the UNICEF Young People's Participation and Mental Health guide.
    - Strategy 2: Work with the Economic Development Department and Erie MakerSpace to develop a support network for young people interested in entrepreneurship and apprenticeships.
        - IYF and Ashoka's Youth Initiative have resources for funding and to support the creation of this network.

Partnership Opportunities
    - Strategy 1: Work with the P.L.A.Y. Education Corporation and Town recreation and community centers to expand engagement events for youth, such as free late-night events for teens, in historically underserved communities.
        - UNICEF and Denver Youth provide resources, and nearby libraries in the High Plains Library District and Baltimore City's Youth Engagement Strategy have examples of events.
    - Strategy 2: Work with the Erie Community Library and Erie Community Center to expand skill-focused workshops for high schoolers on topics such as financial education, media literacy, coding, and other job skills.

General Initiatives

- Strategy 1: Consider a ballot initiative for a sales tax to fund sustainability efforts, similar to Denver's Climate Protection Fund and Boulder's Climate Tax.
- Strategy 2: Create a Resilience Specialist position within the Town of Erie.
  - This staff member can coordinate and accelerate the realization of the goals listed in this plan. Until established, incorporate these duties into the existing work of the Sustainability Division until funding is available for a new position.
  - This staff position can report annual resilience plan progress, make regular plan updates, and integrate best practices. They can also work between Town departments, facilitate community engagement, and increase intergovernmental cooperation to share progress, review and refine existing resilience actions, and identify new actions to pursue.

Party room mural at the Erie Community Center.[36]

Conclusion

The Town of Erie's first Resilience Action Plan marks a significant milestone in advancing the community's sustainability and preparedness. Its effectiveness will depend on the sustained commitment of Town staff to regularly review, enhance, and adapt the plan in response to changing circumstances. This process of refinement is a hallmark of a responsive and forward-thinking approach.

Ongoing community engagement is equally essential. While no plan can fully anticipate all future developments, the willingness to incorporate new data, best practices, and public input will be critical to maintaining the plan's relevance.

Elements of resilience are already incorporated into Town initiatives, and resilience must now, like sustainability, become a foundational principle that guides future planning and decision-making. Resources invested in this area are a responsible use of funds, as reports suggest a return of $13 on every $1 spent.[37] Resilience extends beyond addressing immediate challenges; it encompasses the proactive identification of risks and opportunities, and the development of strategies that improve both current conditions and future outcomes. Through thoughtful planning and adaptive leadership, the Town of Erie is positioning itself to remain well-prepared for the decades ahead.

Photograph of hot air balloons over Schofield Open Space.[38]

Glossary and Acronyms

Definitions

Agrivoltaics: A process that integrates solar energy and productive farmland within the same space for more efficient land use paired with energy production, a potential second revenue source.[39]

Co-benefits: Additional advantages beyond the intended advantages resulting from an action or strategy.[40]

Cool Roof: A type of roof designed to absorb less heat and reflect more sunlight than a traditional roof.[41]

Cover Crops: A strategy used to improve the overall health of the farm and its soil by using crops that fixate nitrogen into the soil to reduce reliance on artificial fertilizers. This is typically accomplished by planting grass, legume, or a combination of the two.[42]

Crop Rotations: A process that focuses on strategically planting crops based on season, soil quality, crop root depth, and other factors. By avoiding continuous repetition of a single crop, soil within an area can be used for agriculture for a longer period of time and more successful production.[43]

Disaster: The Colorado Revised Statutes define a disaster to be "the occurrence or imminent threat of widespread or severe damage, injury, or loss of life or property resulting from any natural cause or cause of human origin, including but not limited to fire, flood, earthquake, wind, storm, wave action, hazardous substance incident, oil spill or other water contamination requiring emergency action to avert danger or damage, volcanic activity, epidemic, air pollution, blight, drought, infestation, explosion, civil disturbance, hostile military or paramilitary action, or a condition of riot, insurrection, or invasion existing in the state or in any county, city, town, or district in the state."[44]

Emergency: The Colorado Revised Statutes define an emergency to be "an unexpected event that places life or property in danger and requires an immediate response through the use of state and community resources and procedures."[45]

Green Roof: A type of roof designed with different layers for purposes such as drainage and insulation to support plant life while protecting the underlying infrastructure. It is also known as a vegetated roof.[46]

Green Streets: A type of street design that uses vegetation, soil, and engineering to manage stormwater runoff and quality.[47]

Low Impact Development Methods: A design process that upholds the ecosystems and water systems present in the environment of an area during development to protect or mimic its processes.[48]

Mitigation: The Colorado Revised Statutes define mitigation as "the sustained action to reduce or eliminate risk to people and property from hazards and their effects."[49]

Pollinator Habitat: A space that provides pollinators, such as bees and butterflies, with food, water, and shelter through a variety of native plants.[50]

Prevention: The Town of Erie Emergency Operations Plan defines prevention as "actions taken to avoid an incident or to intervene in order to stop an incident from occurring."[51]

Rain Garden: A depressed area in the ground with grasses and other plants to collect, slow, manage, and filter stormwater.[52]

Recovery: The Town of Erie Emergency Operations Plan defines recovery as "actions and implementation of programs necessary to help individuals, communities and the environment directly impacted by an incident to return to normal where feasible."[53]

Resilience: The ability of a community to recover from a disaster or persist sustainably in the face of a new, ongoing hardship.

Resilience Hub: A location that supports residents and serves the community by distributing resources before, during, or after a disaster.[54]

Rotational Grazing: A process in agriculture that consists of rotating livestock on grazing land to allow regeneration of healthy grass for the next rotation of livestock.[55]

Sump Pump: A type of pump that removes large amounts of liquid, such as water, from an area, typically a basement of a house or building.[56]

Vegetated Swale: A dry pond with plants and a drain in the center that allows water to naturally pool in the area.[57]

Volatile Organic Compounds: Substances with a high vapor pressure and low water solubility and are typically human-made chemicals. Many products can emit these compounds as a gas and can cause air pollution, leading to adverse health effects.[58]

Wildland-Urban Interface (WUI): An area of transition where undeveloped wildland and developed land, such as cities, meet.[59]

Acronyms

ADA: Americans with Disabilities Act

AI: Artificial intelligence

AQI: Air Quality Index

BIPOC: Black, Indigenous, and People of Color

Boulder AIR: Boulder Atmosphere Innovation Research

CDOT: Colorado Department of Transportation

CDPHE: Colorado Department of Health and Environment

CSA: Community supported agriculture

DI: Disproportionately impacted

DUG: Denver Urban Gardens

EPA: Environmental Protection Agency

EV: Electric vehicle

FEMA: Federal Emergency Management Administration

GARE: Government Alliance on Race and Equity

HEPA: High efficiency particulate air; a type of air filter

HOA: Homeowners association

IECC: International Energy Conservation Code

LEED: Leadership in Energy and Environmental Design

LID: Low impact development

MENV: Masters of the Environment, a masters program at the University of Colorado Boulder

MHFD: Mile High Flood District

MS4: Municipal separate storm sewer system

MVFPD: Mountain View Fire Protection District

NOAA: National Oceanic and Atmospheric Administration

NOx: nitrogen oxides

PM: Particulate matter

PV: Photovoltaics, a method of solar generation

RAP: Resilience Action Plan

RAQC: Regional Air Quality Council

RTD: Regional Transportation District

SFHA: Special Flood Hazard Area

SPEI: Standardized Precipitation Evapotranspiration Index

TMP: Transportation Mobility Plan

USDA: United States Department of Agriculture

USGBC: United States Green Building Council

VMB: Variable Message Board

VOC: Volatile Organic Compounds

WUI: Wildland-Urban Interface

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Appendix A: Vulnerability Assessment

Purpose and Methodology

The Town of Erie is experiencing an increase in extreme weather events that affect residents, the environment, and economy. This report focuses on five climate hazards: air quality, drought, extreme heat, flooding, and wildfires. The purpose of this assessment is to provide historical and scientific context for each hazard as well as related current trends and potential impacts.

According to the NOAA Climate Program Office, vulnerability describes "the degree to which a person or community is at risk, risk being the likelihood of a threat and impact. Impact is determined by the nature and magnitude of the exposure, sensitivity to the exposure, and the capacity of an individual or community to adapt and respond."[1] By analyzing potential vulnerabilities, this report provides necessary background for the Town of Erie Resiliency Action Plan to enact effective methods of resilience, prepare for changes in climate, and provide community support.

ICLEI USA has created a vulnerability matrix to assist with the prioritization of potential hazards a local community might face. Vulnerability is affected and determined by exposure, sensitivity, and adaptive capacity. Exposure refers to the location of "people, assets, and ecosystems" to certain hazards. Sensitivity describes the degree that people, assets, and ecosystems are, or potentially will be, affected by hazards. Adaptive capacity is the ability of people, assets, and ecosystems to adjust to hazards and change while using new opportunities effectively.[2]

Vulnerability Matrix

	Sensitivity	High	Moderate	Low
High		Moderate	High	High
Moderate		Low	Moderate	High
Low		Low	Low	Moderate
		High	Moderate	Low
			Adaptive Capacity	

ICLEI USA vulnerability matrix for hazards.[3]

A good place for local communities to begin assessing their risk and vulnerability is with the Federal Emergency Management Agency (FEMA) National Risk Index mapping tool. This resource uses the expected annual loss, social vulnerability, and community resilience of a county to determine its risk index.[4] Both Boulder County and Weld County currently have a relatively moderate risk index. It is also important to note that hazards can often interact with each other, increasing the damage they cause. According to the Future Avoided Cost Explorer (FACE) tool by the Colorado Water Conservation Board, "drought increases the likelihood of wildfire, which increases the likelihood and impacts of flooding."[5] With the findings of this report, Town officials will have a better understanding of the climate hazards affecting the community and can work to reduce their communities' overall risk.

Town of Erie Background

During the 1860s, the main economic drivers in the area were agriculture and trading goods. After the Civil War, mining became the area's largest and most profitable industry following the discovery of a nearby coal vein. The demand for coal, along with the completion of the Boulder Valley Railroad extension spurred development of Erie's first commercial mine.[6] As more people moved to the area, the Town of Erie was officially established in 1874.

In the 1950s, following World War II, Erie experienced a wave of suburban and economic growth as a result of the newly built Interstate Highway System. "I-25 was completed from Wyoming to New Mexico in 1969."[7] Mining became less profitable for mining corporations as the demand for coal dwindled with the rise of the oil economy, leading to the closure of the Erie coal mines in 1978.

The 1990s marked the beginning of rapid housing development in Erie, bringing thousands of new residents. Between 2000 and 2010, the population grew from 6,291 residents to over 18,000 people. In 2025, the population has increased to over 40,000 people with an expected buildout to 80,000 residents by 2050 to 2055.[8]

As the population continues to expand, The Town of Erie works with its partners to manage growth responsibly while preserving natural resources, a high quality of life, and its small town identity. Central to this vision is ensuring that Erie is positioned to adapt and thrive in the face of future challenges.

Climate Vulnerabilities

Air Quality

Poor air quality is a hazard facing much of the Front Range of Colorado. The Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE) provide a tool called the Air Quality Index (AQI). The AQI is a color-coded system in which air quality is categorized based on the levels of ground level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide.[9] The EPA and CDPHE use the AQI to communicate human health hazards associated with current measurements to the public.

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AQI Basics for Ozone and Particle Pollution

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Air Quality Index Chart.[10]

Ground level ozone forms when nitrogen oxides (NOx) and volatile organic compounds (VOCs) react in the presence of heat and sunlight.[11] Internal combustion engine exhaust, power generation, and oil and gas operations are common sources of these ozone precursors.

Particulate matter (PM) refers to fine air pollutants that are small enough to be inhaled. CDPHE monitoring focuses on PM10 and PM2.5 particles, which are equal to or smaller than 10 micrometers and 2.5 micrometers in diameter, respectively. For reference, a human hair is 50 to 70 micrometers wide.[12] Common sources for PM include vehicle exhaust, wildfire smoke, and dust from disturbed earth.

In addition to the CDPHE monitoring, Erie has deployed five monitoring stations near oil and gas wells to monitor for volatile organic compounds, particulate matter, and meteorological data. Erie also hosts a Boulder A.I.R. monitoring station at the Erie Community Center. This station, in addition to the pollutants monitored for AQI, monitors for several volatile organic compounds as well as methane, a potent greenhouse gas.[13]

According to CDPHE, short-term exposure to air pollutants can result in difficulty breathing, asthma attacks, and airway irritation. Long-term exposure can result in cardiovascular disease, reduced lung function, and premature death. Populations more susceptible to impacts from poor air quality include children, older adults, outdoor workers, and people with preexisting conditions like asthma.[14] In addition to human health, poor air quality can negatively impact soil chemistry, photosynthesis, and crop growth.[15]

According to the Boulder County Hazard Mitigation Plan, counties in the Denver and North Front Range areas continue to be in ground-level ozone nonattainment, meaning that ozone levels are in excess of federal standards. Additionally, poor air quality is highly likely to continue impacting the area while posing a severe threat to public safety.[16]
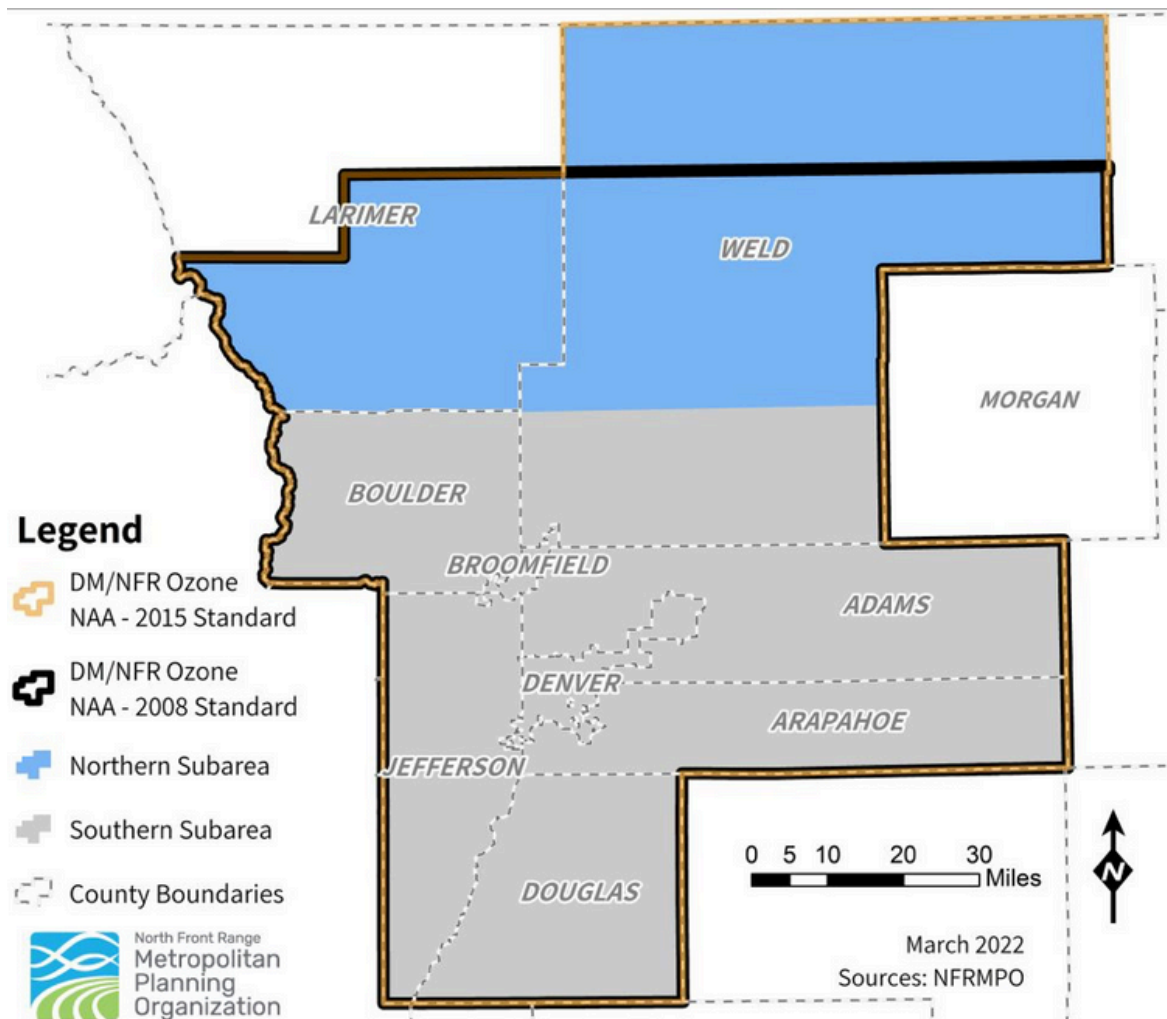
Map of the North Front Range Ozone Nonattainment Area.[18]

Radon, a naturally occurring gas produced from the breakdown of uranium-containing granite, also poses an indoor air quality risk to Erie residents. It is a carcinogen that is a leading cause of lung cancer in the United States. Approximately half of all Colorado homes have radon levels in excess of the EPA's recommended level.[17]
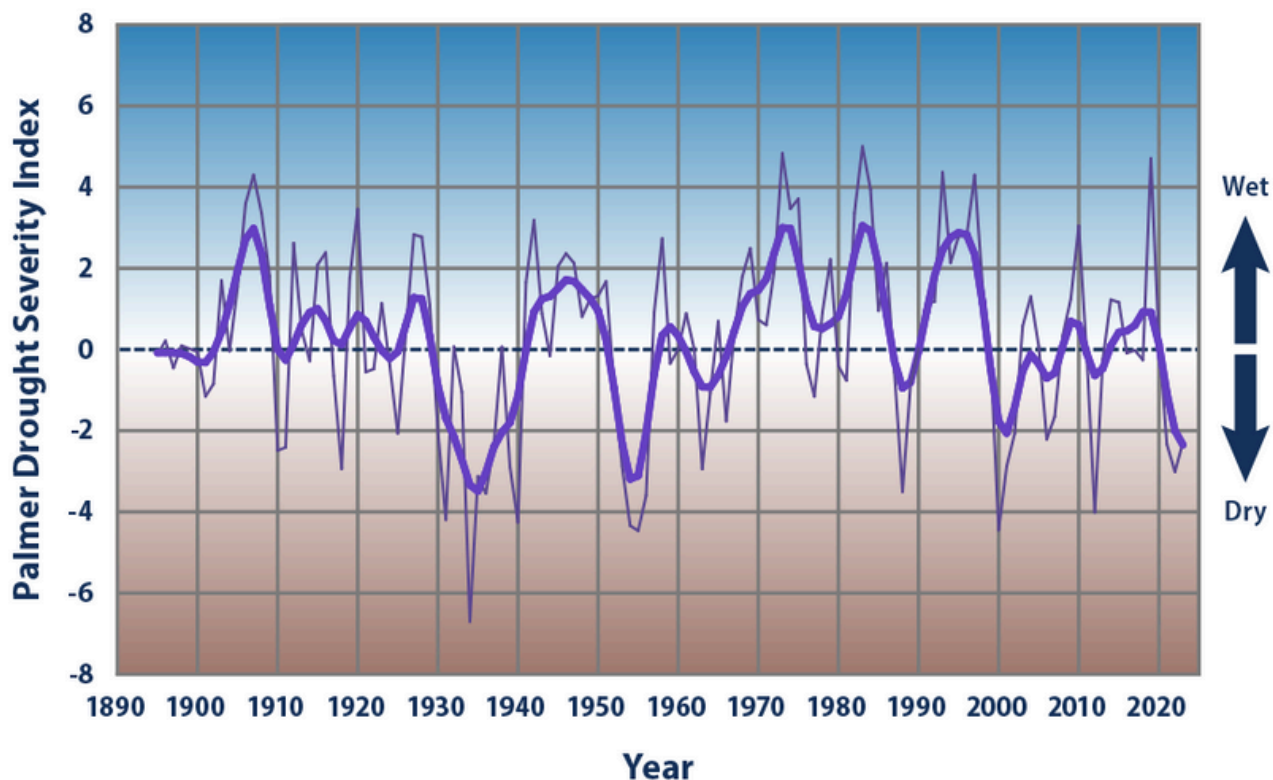
Drought

Droughts are another potential point of vulnerability within the Town of Erie. In 2002 and 2012,[19] the Town experienced intense droughts caused by drastically low levels of precipitation, snowpack accumulation, and streamflows compared to average levels across the state.[20] This led to the development of a three-tiered water restrictions program in Erie, followed by a Drought Management Plan in 2015 and a Drought and Water Supply Shortage Plan in 2021.[21] The period of a drought can change, either happening quickly and lasting for a season or having a gradual onset and lasting for decades.[22]

Due to the importance of water for daily functions, droughts have the potential to cause lasting negative impacts to agriculture in Colorado, particularly to crop production and livestock feed supplies. The 2011 to 2013 drought caused about $633 million in damage within the state. If this drought occurred under predicted 2050 climate conditions, costs would have increased to $639 million. The Colorado recreation industry, particularly any snow- and water-based activities, is also vulnerable to drought.[23] Droughts also have the potential to impact residential water rates as well as the quality of life for the wildlife and natural environment.

Because there are many factors that contribute to drought, there are several indices for drought severity. The Palmer Drought Severity Index is the most commonly used and is derived from temperature and precipitation data at weather stations. A value of zero represents the standard moisture conditions based on data from 1931 through 1990 for a specific region. Negative values represent drier than average conditions, and positive values represent wetter than average conditions.[24]

Another method of measuring the impact of droughts is the Standardized Precipitation Evapotranspiration Index (SPEI), which uses precipitation and evapotranspiration data to show if an environment is balanced in its inputs and outputs. Values between -1 and 1 are considered the baseline. Values below -1 indicate drought conditions, and values above one indicate moist conditions. [25]

From the Palmer Drought Severity Index, moisture conditions within the last five years are drier than average across the contiguous 48 states of the United States.[26]

Graph showing average drought conditions from 1895 to 2023 according to the Palmer Drought Severity Index for the contiguous 48 states.[27]

By focusing on the State of Colorado in the SPEI graph, data from 1900 to 2023 indicates that drought conditions have also steadily increased.[28]

Change in SPEI
- 3: More extreme moisture
- 2
- 1
- 0
- -1
- -2
- -3: More extreme drought
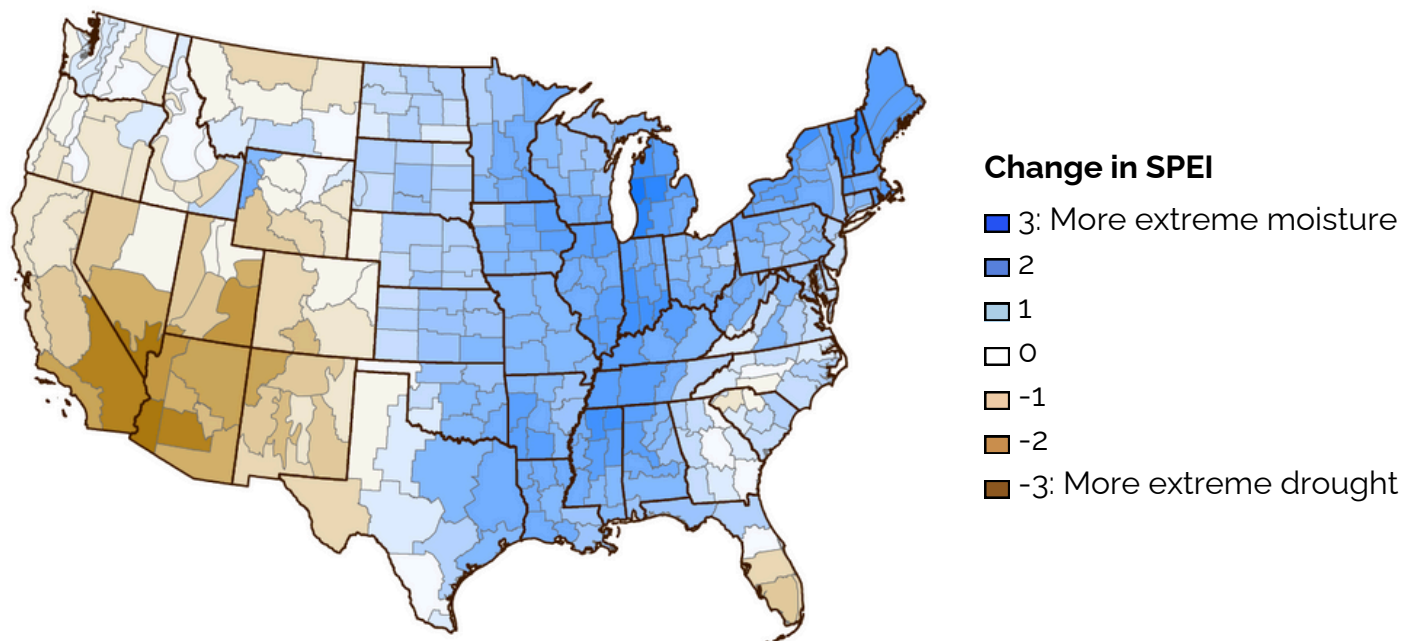
Map of average change in drought conditions from 1900 to 2023 in the contiguous 48 States, from the SPEI.[29]

The U.S. Drought Monitor shows this trend has continued into present day, but both Boulder and Weld counties are currently experiencing lower levels of drought conditions.[30]

Drought Intensity
☐ None
☐ D0 Abnormally Dry
☐ D1 Moderate Drought
☐ D2 Severe Drought
☐ D3 Extreme Drought
☐ D4 Exceptional Drought
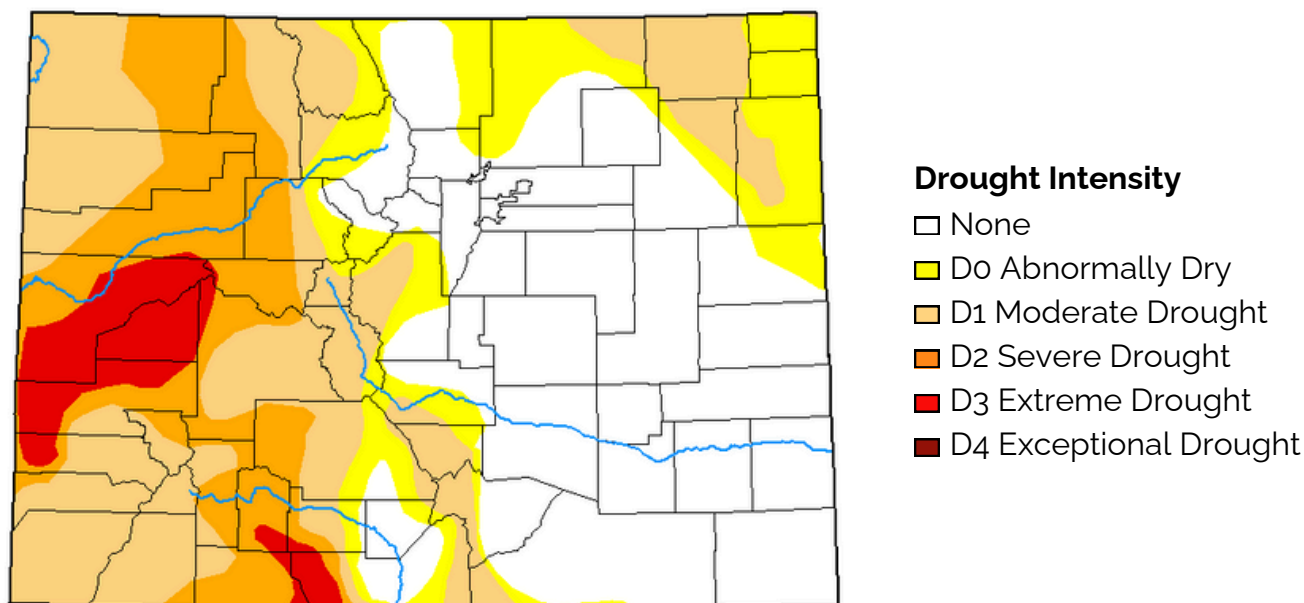
Map of drought intensity in Colorado on June 10, 2025.[31]

According to the Colorado Climate Preparedness Roadmap, droughts are expected to increase due to stagnant precipitation patterns, increasing temperatures, and earlier runoff seasons, thus limiting water supply from mountain sources.[32] With drought, vulnerable populations include older adults, infants and children, people with lower incomes, and people with chronic medical conditions, especially with heat often being a coinciding climate factor when droughts occur.[33] It is essential to continue expanding water management measures to protect against any increase in drought conditions within the western region of the United States.

Extreme Heat
Rising temperatures are occurring globally and within Colorado. These rising temperatures are primarily a result of human activity and greenhouse gas emissions following the Industrial Revolution. Temperatures are measured against a preindustrial baseline to determine the change over time. Colorado has experienced a temperature increase of 2.9°F since 1895.[34]

According to the Climate Change in Colorado report, one way to quantify extreme temperatures is by determining the exceedance of an absolute threshold such as the number of days above 95°F. Additionally, heat waves can be calculated by measuring consecutive days that exceed a relative threshold for a specific area. "Heat waves are defined as a four-day period in which the daily mean temperature (the sum of the daily maximum and minimum temperatures divided by two), averaged over the four days, exceeds the four-day average temperature that was exceeded on average once per year during 1971 to 2000."[35]

The incidence and severity of extreme temperatures in Erie are expected to increase as global temperatures rise. Per the Climate Change in Colorado Report, Colorado's average annual temperature has already increased statewide by 1.4°F from a 1971 to 2000 baseline.[36] Modeling suggests the state will warm by 2.5 to 5.5°F by 2050 and 3 to 6.5°F by 2070 compared to this baseline.[37] This is based on a medium-low emissions scenario.
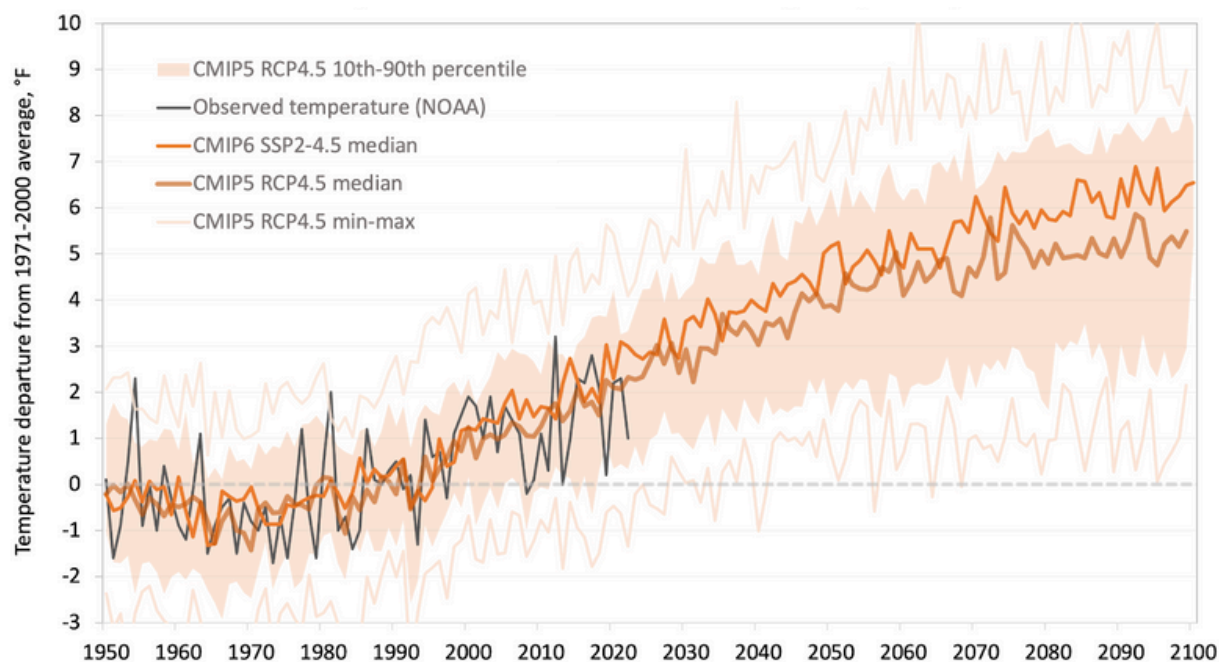
Graph showing historic and projected Colorado annual average temperatures from 1950 to 2100.[38]

If global average temperatures rise 2°C, modeling shows that Colorado's Eastern Plains will see 20 days per year above 95°F by 2050.[39] Depending on emissions reductions, this could reach 44 to 83 days per year by the end of the century. For reference, Erie experienced roughly eight days per year above 95°F between 1961 to 1990.[40]
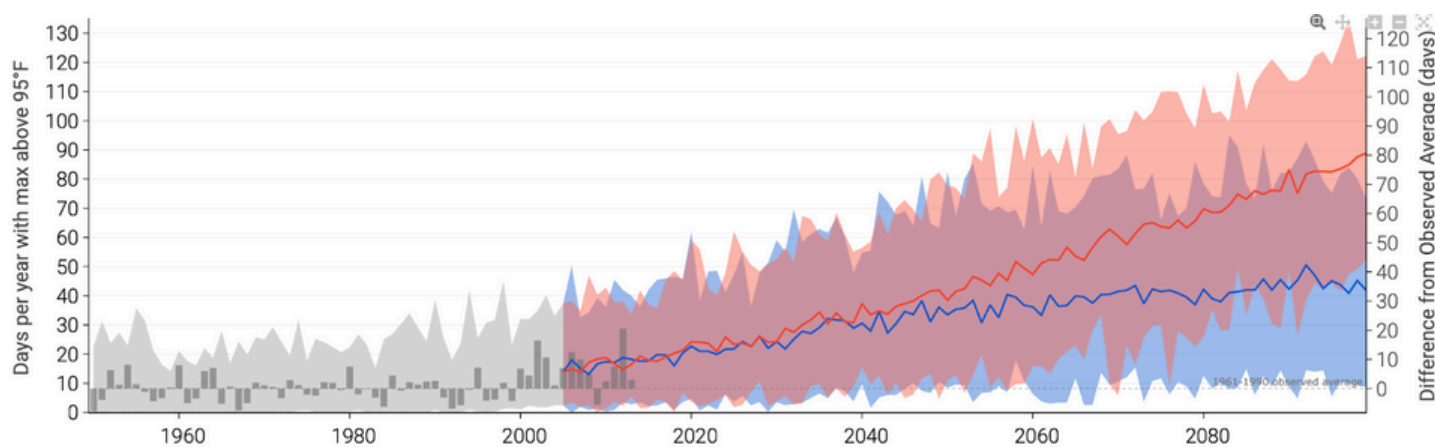
Graph showing projected Erie days above 95°F.[41]

Heat waves, similarly, are projected to increase. "In most regions [of Colorado], the median number of projected heat waves is expected to increase from one per year during 1971 to 2000...to approximately 10 per year by the 2060s."[42]

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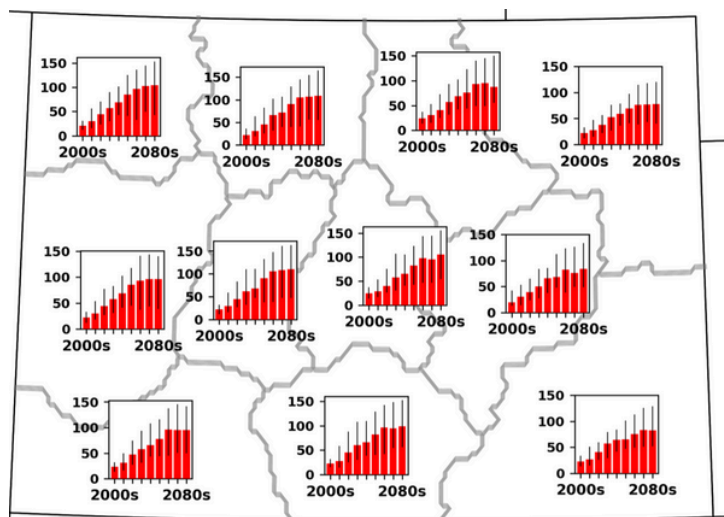
Map of Colorado showing projected heat waves per decade in the 21st century.[43]

Extreme heat can be deadly when a person's body is unable to sufficiently cool itself. Vulnerable populations include outdoor workers and athletes, people experiencing homelessness, children, older adults, people with chronic health conditions, and pregnant women. Additionally, residents that lack air conditioning or the means to pay for it are at a greater risk of heat illness.[44] Extreme heat days create an environment where daily heat-related hospitalizations increase, primarily from ailments such as heatstroke, fainting, throbbing headache, rapid heart rate, and advanced dehydration.[45]

Flooding

Events of extreme precipitation cause flooding when a large and rapid influx of water overwhelms the drainage infrastructure. A floodplain is an area of land surrounding or adjacent to a river or wetland that is more prone to flooding when precipitation occurs. Flooding has occurred in and around Coal Creek multiple times throughout the history of Erie. In 1890, the Town experienced a devastating flood that wreaked havoc on the community and infrastructure. In 1921, "Erie experienced the biggest flood in its history."[46]
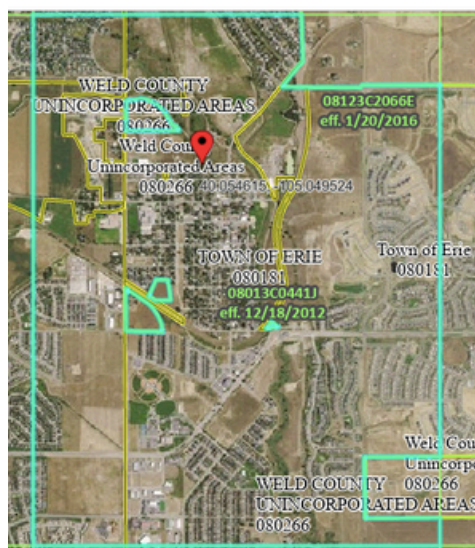
SFHA boundary map for Erie, Colorado highlighted in light blue.[47]

The historical prevalence of flooding and current flood risk in Erie has allowed the Federal Emergency Management Agency (FEMA) to list a portion of Erie as a Special Flood Hazard Area (SFHA). The map above depicts properties within the SFHA boundary that are required by law to obtain flood insurance because their property has a 1% chance or greater to experience flooding annually.[48] Some cities decide to not allow new development on SFHAs altogether.

In 2013, the Town of Erie experienced a disastrous flood. From September 9th to 13th, roughly, 15 inches of rain fell over Erie. This flooding event was so destructive that it cost an estimated $4 billion in infrastructure damage across Colorado.[49]

After the 2013 floods, FEMA allocated public assistance funding across Colorado for reconstruction of damaged infrastructure. $186,044,924.26 was given to Boulder County, while $20,304,746.35 was given to Weld County to rebuild what was damaged in the flood. $57,121,301 were allocated to Colorado municipalities to build backup energy generators, create educational material, flood mitigation plans, and for flood infrastructure improvements.[50]

Chance of seeing a flood during the term of a typical 30-year mortgage

- 🟩 6% or less
- 🟩 6% to 26%
- 🟨 26% to 50%
- 🟧 50% to 75%
- 🟥 Over 75%
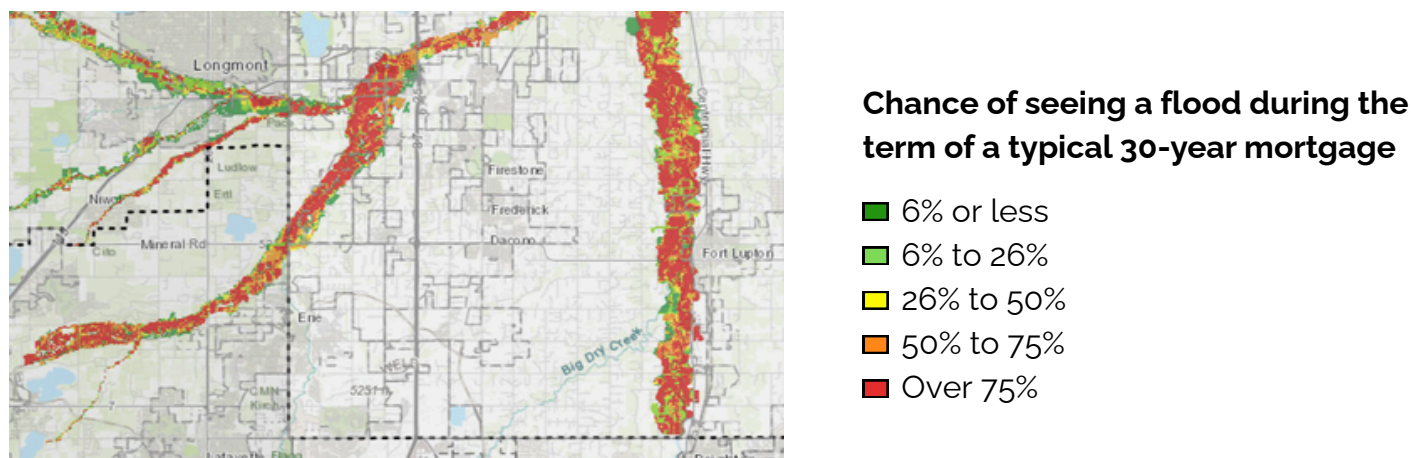
Erie floodplain map for a 30 year flood. The dashed line represents Boulder and Weld County Line.[51]

The Town of Erie invested further into flood mitigation infrastructure and preparedness. In this effort, the Town collaborated with the Mile High Flood District and initiated the Coal Creek Expansion Project. This project enhanced flood protection by widening Coal Creek, reinforcing levees, and improving drainage infrastructure with a goal to reduce floodplain impacts and increase community resilience. These infrastructure improvements explain why the Town of Erie shows such a low flood risk within the annual and 30 year projections from the Colorado Hazard Mapping Portal.[52] However, according to the EnviroScreen tool, the census block south of Old Town, including the Erie Municipal Airport, has the most land area (25%) that has a one percent or greater chance of annual flooding.[53]

The likelihood of flooding corresponds to the intensity of precipitation and the ability of that water to infiltrate into soil, bodies of water, and drainage systems. Based on the Climate Change Colorado Report for every one degrees Celsius increase in temperature the atmosphere can hold **58**

3.5 to 6% more moisture. This is because higher temperatures cause air and water molecules to separate, thus increasing their holding capacity. This increase in moisture has a strong correlation to increased extreme precipitation events. As projected temperatures continue to rise, the rainfall events may be less frequent without much change in annual precipitation totals. This points to more intense rainfall in less overall precipitation events. As precipitation patterns change and the likelihood of drought in the warmer months increases, the drying out of the soil exacerbates the lack of water infiltration, causing an increased likelihood of flash flooding in the spring and early fall.[54]

While the Town's investment in mitigation infrastructure makes floods far less likely to cause severe damage, citizens of Erie should remain vigilant about flood alerts and warnings. The Mile High Flood District works together with FEMA to update and inform the Floodplain Map for Erie and surrounding areas.

Legend
Dashed lines are county borders.

Floodplains (Non-FEMA)
◼ Floodway
◻ 100-Year Shallow Flooding
◼ 100-Year Floodplain (1% Annual Chance)
◻ 500-Year Floodplain (0.2% Annual Chance)

FEMA NFHL Flood Hazard Zones
◻ 1% Annual Chance Flood Hazard
▨ Regulatory Floodway
⬡ Special Floodway
◻ Area of Undetermined Flood Hazard
◻ 0.2% Annual Chance Flood Hazard
▨ Future Conditions 1% Annual Chance Flood Hazard
▨ Area with Reduced Risk Due to Levee
▨ Area with Risk Due to Levee

The Mile High Floodplain Map for Erie as of June 2025.[55]

Wildfires
Wildfires are common within the state of Colorado and have ranged in size and intensity. There were several notable wildfires within Boulder County, such as the Black Tiger Fire in 1989, the Fourmile Canyon Fire in 2010, and the Marshall Fire in 2021. Boulder County has noted that wildfires occur year-round, with the most catastrophic fires arising from human causes and increasing in severity due to unhealthy forests.[56] With these events, both Boulder and Weld counties have worked to increase fire mitigation strategies such as vegetation management[57] and burn permits.[58]

To quantify wildfire risk, the United States Department of Agriculture (USDA) Forest Service determines risk by hazard and vulnerability. Hazard consists of the likelihood and intensity of a wildfire, and vulnerability consists of exposure and susceptibility.[59] Exposure refers to the proximity of potential hazards such as nearby vegetation. Susceptibility describes how easily a home can be damaged by a wildfire without taking mitigation methods into account.[60] According to the USDA, houses in Erie have a medium risk for wildfires which is "greater risk than 56% of communities" in the United States.[61]

Wildfire Risk Scale to Homes
Bolded lines are town borders.
Dashed lines are county borders.
Striped lines are risk calculation area borders.

- ☐ Low risk
- ☐
- ☐ Moderate risk
- ☐
- ☐ High risk
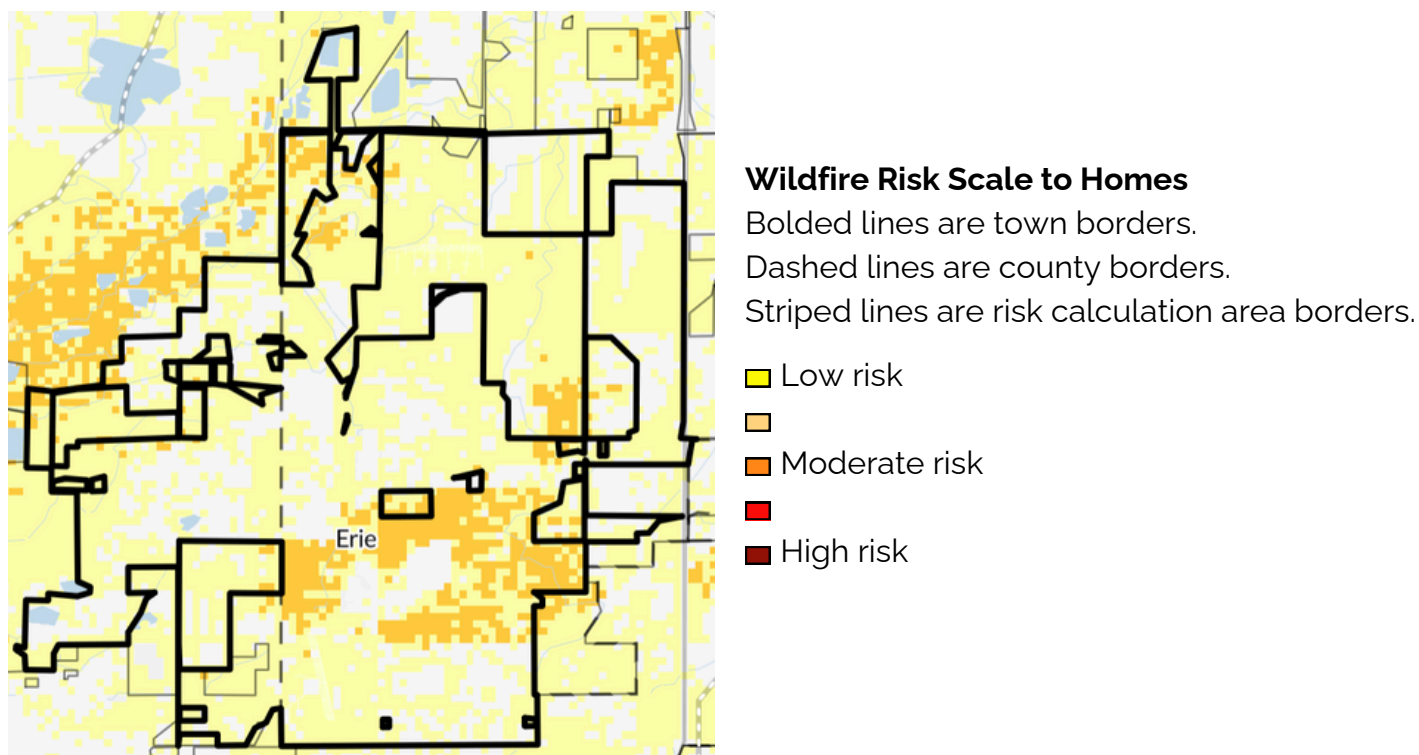
Map of wildfire risk to homes in the Town of Erie.[62]

In terms of hazard, Erie has a moderate likelihood, which is a "greater wildfire likelihood than 58% of communities" in the United States.[63] Erie also has 84% of its buildings located in a minimal exposure zone, which is defined as an area where buildings are unlikely to be subjected to wildfire. 2% of buildings are in an indirect exposure area where ignition by embers or close proximity to another building is likely. 14% of buildings are in a direct exposure zone where ignition may occur due to flying embers or nearby vegetation and buildings.[64]

The Colorado State Forest Service has also analyzed wildfire risk using factors such as canopy cover, building damage potential, and burn probability. Within Boulder and Weld counties, the Erie area falls under no wildland-urban interface (WUI) risk or low WUI risk.[65] WUI refers to "areas where human habitation and development meet or intermix with wildland fuels."[66] The Town also has low building damage potential. With regards to potential fire intensity, the Town of Erie mostly has a low to moderate intensity, with some areas that have a probable high fire intensity. [67]
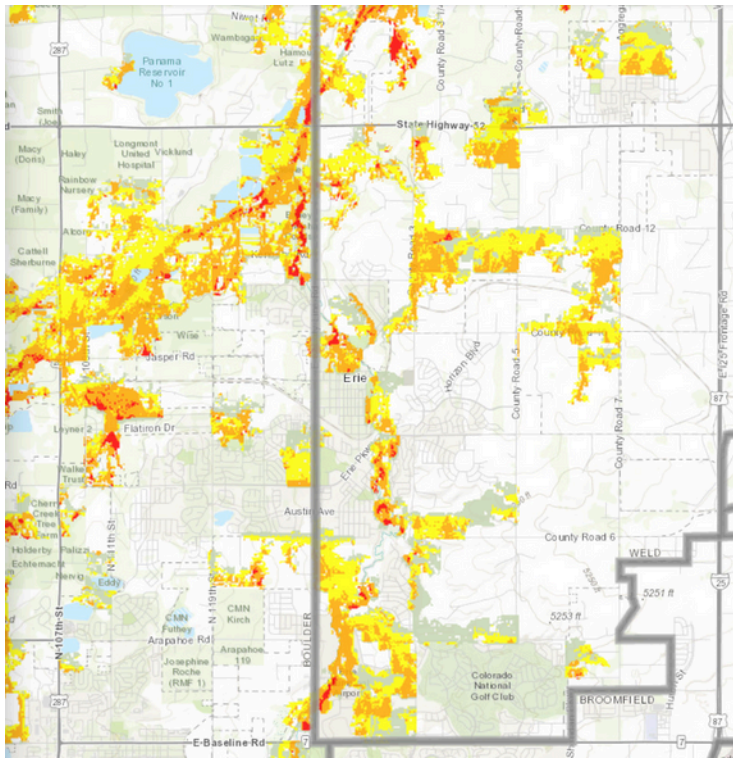
Fire Intensity Scale
Thick dark gray lines are county borders.

☐ Lowest Intensity
☐ Low Intensity
☐ Moderate Intensity
☐ High Intensity

Map of probable fire intensity in the Town of Erie.[68]

The Colorado State Forest Service also created a heat map that shows the past ignition trends, which can predict the likelihood of a wildfire.[69]
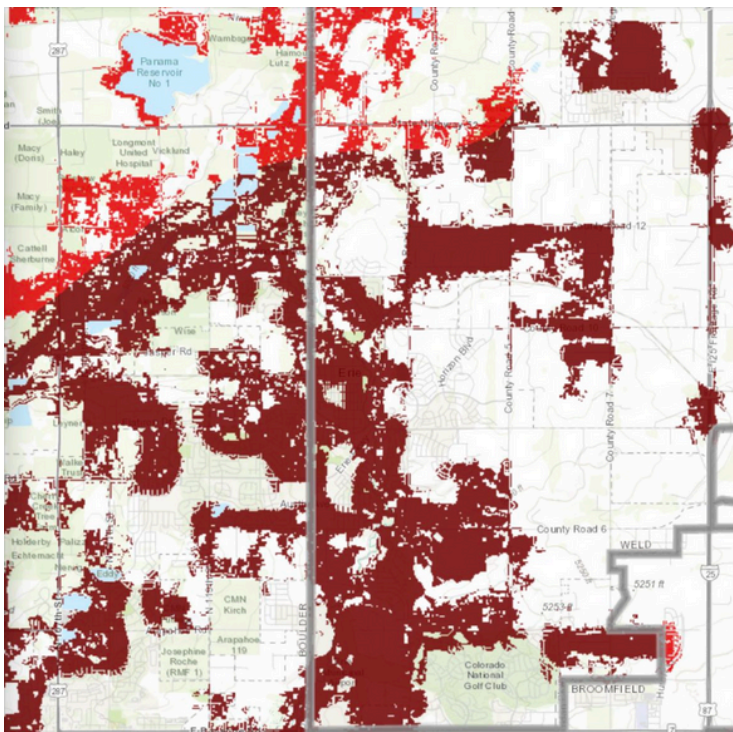
Fire Ignitions Scale
Thick dark gray lines are county borders.

☐ 1: Lowest Occurrence
☐ 2
☐ 3
☐ 4
☐ 5: Moderate Occurrence
☐ 6
☐ 7
☐ 8
☐ 9: Highest Occurrence

Heat map of past fire ignitions in the Town of Erie.[70]

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Wildfires also have some common interactions with other climate hazards. According to the Colorado Climate Preparedness Roadmap, the smoke from wildfires increases particulate matter in the air, lowering overall air quality in nearby regions.[71] The resultant loss of vegetation and diminished water absorption capacity of the soil also makes land affected by wildfires more susceptible to flash floods and surface-level floods.[72] This roadmap also provided statistics on future wildfire risk when compared to the past decades of the 20th century. It is estimated that "the annual amount of land area burned could increase between 100% and 500% by the mid 21st century."[73] Due to social and economic conditions, older people, people with mobility challenges, families in poverty, and people living in mobile homes are more vulnerable to wildfire.[74] Thus, while the fires may not be severe, it is important to enact fire mitigation and prevention measures to improve the overall safety of the community.

Social Vulnerability

While natural hazards may strike a region as a whole, their impacts are not felt equally among all residents. Various factors such as age, income, race and ethnicity, educational attainment, preexisting health conditions, disability, household makeup, and proximity to hazards and pollutants shape how vulnerable different populations are. Understanding these patterns is essential to ensuring that all residents can prepare for, respond to, and recover from hazards equitably.

Erie is, in many ways, a thriving and well-resourced community. The Town's current population of just over 40,000 is projected to reach 75,500 by 2050, and the median household income is $163,644. Educational attainment is high, with 67% of residents holding at least a bachelor's degree. Nearly all residents live within a mile of a park, and public transportation options are expanding, including youth access to free transit and a new Flex Ride service launching in 2025.[75] By many indicators, Erie ranks among the highest in the country for life expectancy, wealth, and education access.

When we look closer, patterns of vulnerability emerge beneath these averages. The population is 83.2% white and 16.8% are people of color. 10.4% of residents identify as Hispanic or Latino, and 1.4% have limited English proficiency. This can create barriers to communication and access to critical services, particularly in emergencies. Children under five make up 6.3% of the population, and about 10% of residents are over 65. Notably, 5.8% of older adults live alone, and 7.3% of households are led by single women, some with young children.[76] Both of these groups may face increased challenges in times of crisis.

Though the majority of households earn over $75,000 annually, a portion of the population faces economic insecurity. Approximately 3% of residents live in poverty, with 1.4% classified as being in "deep poverty," defined as earning less than half the federal poverty level.[77] About 6.1% of residents have disabilities, 2.9% lack health insurance, and 2.5% of adults over 25 do not have a high school diploma.[78] Among working-age adults, 13% are not employed, which can further limit access to healthcare and financial stability.[79]

Geographically, these vulnerabilities are not evenly distributed. Old Town Erie, particularly the area stretching between Reliance Park in the north and Erie Community Park in the south, shows higher levels of social and environmental risk.[80] This central corridor has the highest concentration of low-income residents at 15%, households that are housing cost-burdened at 34%, and people of color, at 33%.[81] It also shows lower educational attainment, with 7% of adults holding only a high school diploma.[82]

This same central area stands out for its elevated environmental and climate risks. It ranks in the 95th percentile nationwide for potential economic and life loss from natural disasters, including wildfire and flooding.[83] Manufactured home neighborhoods, some of which fall within this central zone, are also recognized by the State of Colorado as disproportionately impacted due to a combination of income, housing, and demographic factors.[84]

By contrast, other parts of Erie appear more prepared for these risks. The eastern portion has some of the highest life expectancy rates in the country, with residents highly likely to live to 90 or older.[85] In the northwest corner of the town, only 5% of the population is considered low-income, and 13% experience a housing cost burden.[86]

Across all census blocks, however, certain vulnerabilities persist. Exposure to air pollution and proximity to oil and gas sites are common concerns. In some areas, particularly those in Weld County, residents experience higher rates of chronic illnesses like diabetes and heart disease. Disability rates range from 4.6% to 8%.[87]

Conclusion of Social Vulnerability
While Erie is not broadly classified as socially vulnerable, important disparities exist, particularly in and around Old Town. This area faces the intersection of environmental exposure, economic hardship, and social factors that can exacerbate vulnerability during disasters. To build a truly resilient and equitable community, Town planning and operations must acknowledge and address these disparities. Prioritizing investments in central Erie can ensure that no one is left behind as the Town continues to grow.

Takeaways and Next Steps
The hazards included in this assessment are often related and exacerbated by climate change. Warming temperatures enable the atmosphere to hold more moisture, increasing the possibility of flooding from intense precipitation events. Higher temperatures and drought can increase the number and intensity of wildfires, creating more particulate air pollution. Wildfire scars can increase stormwater runoff and magnify the threat of flooding. While not covered within this report, additional hazards that affect Erie include thunderstorms, lightning, hail, tornadoes, wind, winter storms, and pandemics.

All the hazards discussed in this report can impact safety, human health, quality of life, infrastructure, local economy, and the environment. The impacts on Erie residents are not equally felt, as some populations are at greater risk due to age, health, income, and other factors.

Understanding current hazards, how they are likely to change in the coming years, and how they might impact Erie is central to local climate adaptation planning. This understanding will allow Town staff to form strategies that reduce vulnerability and increase preparedness, thereby building a community that is equipped to adapt and thrive in a changing environment. An important next step in this process is the creation of Erie's first Resilience Action Plan, a plan that will include a set of actionable items that will serve to mitigate the harm caused by these shocks and stressors.

Acknowledgements

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Appendix B: Community Engagement Data

Overall Data from Town of Erie Events

Total interactions: 926

Top 3 Erie Hazards	Erie Resident	Nonresident
Drought	317	35
Wildfires	297	41
Extreme Heat	257	28
Power Outages	110	18
Flooding	99	6
Other	98	12
Not Sure	28	11
None	7	1
Total	**1213**	**152**

Table 1:
Table of responses on the top three hazards in the Town of Erie from all Town of Erie events the MENV Graduate Student Team attended.

Top 3 Resilience Priorities	Erie Resident	Nonresident
Local Ecosystems, Wildlife, and Trees	262	30
Sustainable Land Use and Transportation Access	263	27
Water Conservation	233	31
Wildfire Mitigation and Disaster Response	178	22
Economic Diversity and Job Access	118	13
Community Connectedness and Education	116	11
Energy Resilience	86	9
Healthcare Access	61	14
Agricultural Support	61	12
Other	59	2
Total	**1437**	**171**

Table 2:
Table of responses on the top three resilience priorities the Town of Erie should take from all Town events the MENV team attended.

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Top Three Hazards: Responses from Erie Residents

Top 3 Erie Hazards	Arbor/ Earth Day	Town Fair	Farmers Market, May 30	Farmers Market, June 12	Farmers Market, June 26	Farmers Market, July 10	Farmers Market, July 24	Erie Fest
Drought	98	73	23	36	19	12	22	34
Wildfires	74	61	27	43	27	15	20	30
Extreme Heat	72	52	17	36	23	8	26	23
Power Outages	18	26	4	30	10	4	3	15
Flooding	22	20	6	9	14	3	12	13
Other	3	12	0	6	5	4	31	37
Not Sure	5	2	3	10	0	0	2	6
None	1	2	0	3	0	1	0	0
Total	**293**	**248**	**80**	**173**	**98**	**47**	**116**	**158**

Table 3: Table of responses from Erie residents on the top three hazards in the Town of Erie from all Town events the MENV Graduate Student Team attended.

Top Three Hazards: Responses from Nonresidents

Top 3 Erie Hazards	Arbor/ Earth Day	Town Fair	Farmers Market, May 30	Farmers Market, June 12	Farmers Market, June 26	Farmers Market, July 10	Farmers Market, July 24	Erie Fest
Drought	8	11	2	5	2	0	0	7
Wildfires	7	10	3	6	4	0	1	10
Extreme Heat	5	8	1	6	2	0	0	6
Power Outages	5	3	1	4	1	0	0	4
Flooding	2	3	0	0	0	0	0	1
Other	0	10	0	1	0	0	0	1
Not Sure	2	4	0	1	1	0	0	3
None	1	0	0	0	0	0	0	0
Total	**30**	**49**	**7**	**23**	**10**	**0**	**1**	**32**

Table 4: Table of responses from nonresidents on the top three hazards in the Town of Erie from all Town events the MENV team attended.

Top Three Resilience Priorities: Responses from Erie Residents

Top 3 Resilience Priorities	Arbor/ Earth Day	Town Fair	Farmers Market, May 30	Farmers Market, June 12	Farmers Market, June 26	Farmers Market, July 10	Farmers Market, July 24	Erie Fest
Local Ecosystems, Wildlife, and Trees	68	59	17	34	28	12	20	24
Sustainable Land Use and Transportation Access	73	47	16	44	21	13	22	27
Water Conservation	68	51	17	31	23	8	14	21
Wildfire Mitigation and Disaster Response	55	26	19	26	20	5	9	18
Economic Diversity and Job Access	25	21	12	18	6	6	21	9
Community Connectedness and Education	25	31	9	14	7	6	11	13
Energy Resilience	21	15	2	18	11	5	2	12
Healthcare Access	23	5	5	9	0	3	4	12
Agricultural Support	10	11	10	13	5	4	5	3
Other	5	20	15	8	3	0	2	6
Total	**373**	**286**	**122**	**215**	**124**	**62**	**110**	**145**

Table 5: Table of responses from Erie residents on the top three resilience priorities the Town of Erie should take from all Town events the MENV Graduate Student Team attended.

Top Three Resilience Priorities: Responses from Nonresidents

Top 3 Resilience Priorities	Arbor/ Earth Day	Town Fair	Farmers Market, May 30	Farmers Market, June 12	Farmers Market, June 26	Farmers Market, July 10	Farmers Market, July 24	Erie Fest
Local Ecosystems, Wildlife, and Trees	6	9	1	4	3	0	0	7
Sustainable Land Use and Transportation Access	3	8	2	6	1	0	1	6
Water Conservation	9	6	1	5	3	0	0	7
Wildfire Mitigation and Disaster Response	4	7	0	5	2	0	1	3
Economic Diversity and Job Access	1	6	1	1	2	0	0	2
Community Connectedness and Education	1	4	1	3	1	0	0	1
Energy Resilience	1	0	1	3	1	1	0	2
Healthcare Access	1	1	0	3	2	0	0	7
Agricultural Support	2	4	1	0	1	1	0	3
Other	0	2	0	0	0	0	0	0
Total	**28**	**47**	**8**	**30**	**16**	**2**	**2**	**38**

Table 6: Table of responses from nonresidents on the top three resilience priorities the Town of Erie should take from all Town events the MENV Graduate Student Team attended.

Number of Interactions from Town of Erie Events

Number of Interactions	Arbor/ Earth Day	Town Fair	Farmers Market, May 30	Farmers Market, June 12	Farmers Market, June 26	Farmers Market, July 10	Farmers Market, July 24	Erie Fest
Interactions from People	194	250	93	120	82	28	55	104

Table 7: Table of number of people that interacted with the MENV team during each event they attended.

Top Three Hazards: Responses for the Other Category

Arbor/Earth Day
Hail, Coal Creek flooding.

Town Fair
Big oil, too many planes and aircraft, littering, too much growth, individualism.

Farmers Market, May 30
There were no responses for "other" for the hazards question recorded during this event.

Farmers Market, June 12
Overdevelopment.

Farmers Market, June 26
Road safety, overdevelopment, infrastructure.

Farmers Market, July 10
Grasshoppers, cell service for emergencies.

Farmers Market, July 24
Sprawl, hail.

Erie Fest
Traffic, oil and gas, income levels, community building, hazards.

Top Three Resilience Priorities: Responses for the Other Category

Arbor/Earth Day
Affordable housing.

Town Fair
Food markets.

Farmers Market, May 30
Overbuilding, lagging infrastructure, connected trails, safer crossings on major roads, indoor play areas for kids to use during the winter, progress with commercial facilities, more grocery stores.

Farmers Market, June 12
Civil unrest, unchecked growth, cell towers, water prices, and transportation access.

Farmers Market, June 26
5G Service.

Farmers Market, July 10
Advanced and specialty medical access.

Farmers Market, July 24
Water resource development and commercial development.

Erie Fest
Senior care.

Defining Resilience: Open-Ended Responses

Arbor/Earth Day
Resilience: The ability to overcome hard times and create a more beautiful future from those hard times.
Able to handle extreme events with minimal negative effects.
An infrastructure that supports and can withstand changes.
Recycling and Composting (waste).
Planting trees.
Protection from extreme weather.
Building habitats and gardens.
Pushing ahead with solutions for problems.
Support our pollinators.
Walkability.
Sustainable business plans and practices.
Survival in all conditions.

Town Fair
Diverse neighborhoods, interconnectivity, economy and entrepreneurship, walkability.
Affordable housing for people to have access to lower wage jobs.
Affordable living (housing transportations, groceries, etc.; more inclusive than housing).
The goats were brilliant!
More parks that have diverse equipment.
Wildfires.
Less focus on car-based convenience, more bikeability and walkability to all services.
Slow development.
Construction: stop blocking residents in (Old Town).
Long term stability regarding (finances?) and water (among other public services).
The community could use a cricket ground in the parks and rec center, but we appreciate the transportation improvements.
Community.
The town should align growth with water availability and taps.

Town Fair, Part 2
Volunteerism to help open space and do creek cleanups, better creek access near new development, maybe a duck race fundraiser.
The Town needs more industry with the residential growth; it is basically a bedroom community.
Crisis resilience for different environmental (floods, etc.) through city institutions.
Resilience is being prepared in order to respond.
The ability of a community, regardless of economic status, to make it through hard times.
Listen to all voices.

Farmers Market, May 30
Always getting back up again!
Being creative! Finding innovative solutions for tough problems.
Never giving up no matter what!
Oil drilling under my house is awful!
Morgan Hill park: We don't want it built so we can preserve nature.
I moved from a town that quadrupled in size in 10 years, don't let that happen here.

Farmers Market, June 12
The ability to bounce back.
Strong.
Standing up to a challenge.
Asset management.

Farmers Market, June 26
Strong and diverse ecosystem.
To overcome hardships and hazards as a connected community.
Better air quality.
To recover from adversity.

Defining Resilience: Open-Ended Responses

Farmers Market, July 10
Keep on trying.

Farmers Market, July 24
Planning for 7 generations ahead, without causing harm now, long term sustainability.

Erie Fest
There were no open-ended responses recorded during this event.

Memorandum

To: Erie Town Council
From: Eryka Thorley, Sustainability Manager
Date: January 30, 2026
Re: Resilience Action Plan Questions Raised

Cost Impact of Energy Efficiency Codes and Building Electrification:

Although the Resilience Action Plan does not propose specific changes to the Erie building Codes, to address Council Members' concerns with the cost of codes on housing costs, staff conducted a search of information on the topic. There are conflicting reports about the impact of energy efficiency codes and building electrification efforts on the cost and price of homes, as well as the life cycle cost of such measures. The Common Sense Institute (CSI) published The Uncertain Future Cost of Colorado's Energy and Housing based on information from a study conducted by Black Hills Energy that looked at costs of utility infrastructure for retrofitting houses to go all electric, as well as of cost of "behind the meter" costs. The Black Hills Energy study showed total electrification cost per housing unit would range from $32,000 to $37,000. That study did not look at avoided costs for gas infrastructure for new builds, nor did it look at comparative energy costs.

The CSI report also summarized the result of a study the Louisville City Council asked Group 14, a Colorado-based consulting firm with expertise in built environment projects, to prepare a cost analysis to understand the cost differential to build to both the 2018 and 2021 IECC for fire affected homes. Group 14 estimated the cost to upgrade to meet the different iterations of the 2021 IECC (with or without Appendix RC) would incur additional costs to homeowners anywhere from $6,450 - $22,352 per home. The Group 14 study also did not evaluate avoided costs for gas infrastructure for new builds, nor did it look at comparative energy costs. As of early 2025 roughly 70% of those rebuilding from the Marshall Fire had built to 2021 IECC code or stronger code requirements.

The Rocky Mountain Institute (RMI) published The Economics of Electrifying Buildings. That study compared the 15-year net present costs of water hearing and space conditioning in both new construction and retrofit all-electric homes compared to gas homes in four housing markets. It showed costs for all-electric new construction were lower in all cases but retrofit costs were higher in all cases. The summary table of that study is shown below.

		NEW CONSTRUCTION	RETROFIT
OAKLAND	Standard Heat Pump	$11.5	$22.9
	Flexible Heat Pump Default Time-of-Use (TOU) Rate	$11.8	$22.9
	Flexible Heat Pump 3:1 TOU	$10.9	$20.8
	Natural Gas with Existing Air Conditioner (AC)	not applicable	$16.1
	Natural Gas with New AC	$13.7	$24.2
HOUSTON	Standard Heat Pump	$11.5	$19.0
	Standard Heat Pump "Free Nights" Electricity Rate	$13.1	$23.5
	Flexible Heat Pump "Free Nights" Electricity Rate	$12.3	$22.4
	Natural Gas with Existing AC	not applicable	$15.2
	Natural Gas with New AC	$15.1	$21.4
PROVIDENCE	Standard Heat Pump	$14.3	$25.6
	Natural Gas with Existing AC	not applicable	$17.9
	Natural Gas with New AC	$16.6	$24.1
	Heating Oil	$20.9	$26.9
	Propane	$28.0	$39.2
CHICAGO	Standard Heat Pump	$9.6	$19.3
	Natural Gas with Existing AC	not applicable	$12.8
	Natural Gas with New AC	$13.6	$19.2

Legend:
- Electricity
- Natural Gas
- Heating Oil/Propane

The American Council for an Energy Efficient Economy (ACEEE) published a report noting that In States With Strengthened Building Energy Codes, A Quarter Million New Homes Rise, suggesting that strengthened energy codes have not slowed homebuilding. That report concluded, "Modern building energy codes are a key housing affordability tool. By ensuring all new homes meet minimum standards for energy efficiency, codes save new and future residents money on utility bills and reduce the overall cost of housing." It also asserted, "[T]he updated code requires better insulation and air sealing, which significantly reduces heating and cooling costs. The bill savings each month dwarf the smaller increase in mortgage payments. Residents also are healthier, are more comfortable, and can stay safe for longer during extreme weather without heating or cooling, saving lives."

It is worth noting that neither costs nor savings to builders are necessarily passed on to home-buyers, since the market determines housing prices and builders will sell new homes at the highest price the market will bear.

Staff would appreciate Council direction on whether this information addresses Council Members' initial concerns regarding the Resilience Plan potentially increasing the costs of new development.

Additionally, a Council Member mentioned concerns with the plan's strategy suggesting the exploration of integrating agrivoltaics as a land use opportunity in future updates to the Unified Development Code. Staff hosted and invited Council to an agrivoltaics webinar with the [Colorado Agrivoltaic Learning Center](#) to more thoroughly explore this unique land use including its ability to enhance crop and animal resilience and increase economic opportunities for farmers. Staff ask for Council direction on this or any other amendments to the Draft RAP Council would like to see.

Based on Council direction, staff will prepare a final RAP for Council adoption. This will allow for plan transition to the next phase of exploring implementation with the new student group, as well as integration into the current Sustainability Action Plan update, which staff will bring to Council later this year.

THE ECONOMICS OF ELECTRIFYING BUILDINGS

HOW ELECTRIC SPACE AND WATER HEATING SUPPORTS
DECARBONIZATION OF RESIDENTIAL BUILDINGS

BY SHERRI BILLIMORIA, LEIA GUCCIONE, MIKE HENCHEN, AND LEAH LOUIS-PRESCOTT

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This report benefitted greatly from review and input by participants in the electrification-focused conversation at RMI's e-Lab Summit, held in October 2017 in Albuquerque, NM. Learn more at www.rmi.org/our-work/electricity/elab-electricity-innovation-lab/elab-summit

Images courtesy of iStock unless otherwise noted.

ABOUT US

ABOUT ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.

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EXECUTIVE SUMMARY

Seventy million American homes and businesses burn natural gas, oil, or propane on site to heat their space and water,[1] generating 560 million tons of carbon dioxide each year—a tenth of total US emissions.[2] Now, with an increasingly low-carbon electric grid comes the opportunity to meet nearly all our buildings' energy needs with electricity,[i] eliminating direct fossil fuel use in buildings and making the gas distribution system—along with its costs and safety challenges—obsolete. Further, electric space and water heating can be intelligently managed to shift energy consumption in time, aiding the cost-effective integration of large amounts of renewable energy onto the grid. And reaching "deep decarbonization" goals of 75% or greater reduction in greenhouse gas emissions will require eliminating most or all of the CO_2 produced by furnaces and water heaters across the country, alongside other measures across the economy.

Achieving this vision will require massive market transformation, including discontinuing the expansion of the gas distribution system, widespread adoption of new appliances in homes and businesses across the country, and new markets for intelligent devices to provide flexible demand to the grid. Eleven million households burn oil or propane for heat—the most carbon intensive and costly fuels—and another 56 million burn natural gas.[3] The most efficient electric devices—heat pumps for space and water heating—have small market share today; many homes need additional electrical work to accommodate them; and consumer awareness of this heating technology option is low.

In this paper, we analyze the economics and carbon impacts of the electrification of residential space and water heating both with and without demand flexibility—the ability to shift energy consumption in time to support grid needs. We compare electric space and water heating to fossil fuels for both new construction and home retrofits under various electric rate structures in four locations: Oakland, California; Houston, Texas; Providence, Rhode Island; and Chicago, Illinois. We focus on the residential sector, which makes up the majority of carbon emissions from buildings' fossil fuel use,[4] but a similar market transformation will be needed in commercial buildings to meet deep decarbonization targets. Cooking, clothes drying, and other end uses are assumed to be electric in all cases.

In many scenarios, notably for most new home construction, we find electrification reduces costs over the lifetime of the appliances when compared with fossil fuels. However, for the many existing homes currently heated with natural gas, electrification will increase costs at today's prices, compared to replacing gas furnaces and water heaters with new gas devices. We find electrification is cost-effective for customers switching away from propane or heating oil, for those gas customers who would otherwise need to replace both a furnace and air conditioner simultaneously, for customers who bundle rooftop solar with electrification, and for most new home construction, especially when considering the avoided cost of gas mains, services, and meters not needed in all-electric neighborhoods. Customers with existing gas service face higher up-front costs to retrofit to electric space and water heating compared with new gas devices, and either pay more for energy with electric devices—in the case of colder climates in Chicago and Providence—or save too little in energy costs to make up the additional capital cost—in the case of Houston and Oakland. Figure 1 illustrates this result, described in more detail in the body of the report.[ii]

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[i] The carbon intensity of the US electric grid in 2017 was 25% lower than in 2007, down from 1,335 lb. CO_2/MWh to 1,002 lb. CO_2/MWh.

[ii] Our scenarios evaluate space heating, air conditioning, and water heating. Air conditioning is already powered by electricity, but its costs are important to include in electrification analysis, since heat pumps provide both heating and cooling and can replace both a furnace and air conditioner with a single device.

FIGURE 1

COMPARISON OF 15-YEAR NET PRESENT COSTS OF WATER HEATING AND SPACE CONDITIONING (THOUSAND $)

	NEW CONSTRUCTION	RETROFIT
OAKLAND		
Standard Heat Pump	$11.5	$22.9
Flexible Heat Pump Default Time-of-Use (TOU) Rate	$11.8	$22.9
Flexible Heat Pump 3:1 TOU	$10.9	$20.8
Natural Gas with Existing Air Conditioner (AC)	not applicable	$16.1
Natural Gas with New AC	$13.7	$24.2
HOUSTON		
Standard Heat Pump	$11.5	$19.0
Standard Heat Pump "Free Nights" Electricity Rate	$13.1	$23.5
Flexible Heat Pump "Free Nights" Electricity Rate	$12.3	$22.4
Natural Gas with Existing AC	not applicable	$15.2
Natural Gas with New AC	$15.1	$21.4
PROVIDENCE		
Standard Heat Pump	$14.3	$25.6
Natural Gas with Existing AC	not applicable	$17.9
Natural Gas with New AC	$16.6	$24.1
Heating Oil	$20.9	$26.9
Propane	$28.0	$39.2
CHICAGO		
Standard Heat Pump	$9.6	$19.3
Natural Gas with Existing AC	not applicable	$12.8
Natural Gas with New AC	$13.6	$19.2

Electricity
Natural Gas
Heating Oil/Propane

WHAT IS DEMAND FLEXIBILITY?

Demand flexibility uses communication and control technology to shift electricity use across hours of the day while delivering end-use services (e.g., cool or warm air, hot water, electric vehicle charging) at the same or better quality but lower cost. It does this by applying automatic control to reshape a customer's demand profile continuously in ways that either are invisible to or minimally affect the customer,

and by leveraging more-granular rate structures that monetize demand flexibility's capability to reduce costs for both customers and the grid.

For water heating and space conditioning, flexible devices preheat or precool during periods of low-cost electricity, in order to use less electricity during high-cost periods.

FIGURE 2

DEMAND FLEXIBILITY CAN SHIFT LOADS INTO TIMES OF HIGH RENEWABLE OUTPUT OR LOW COST
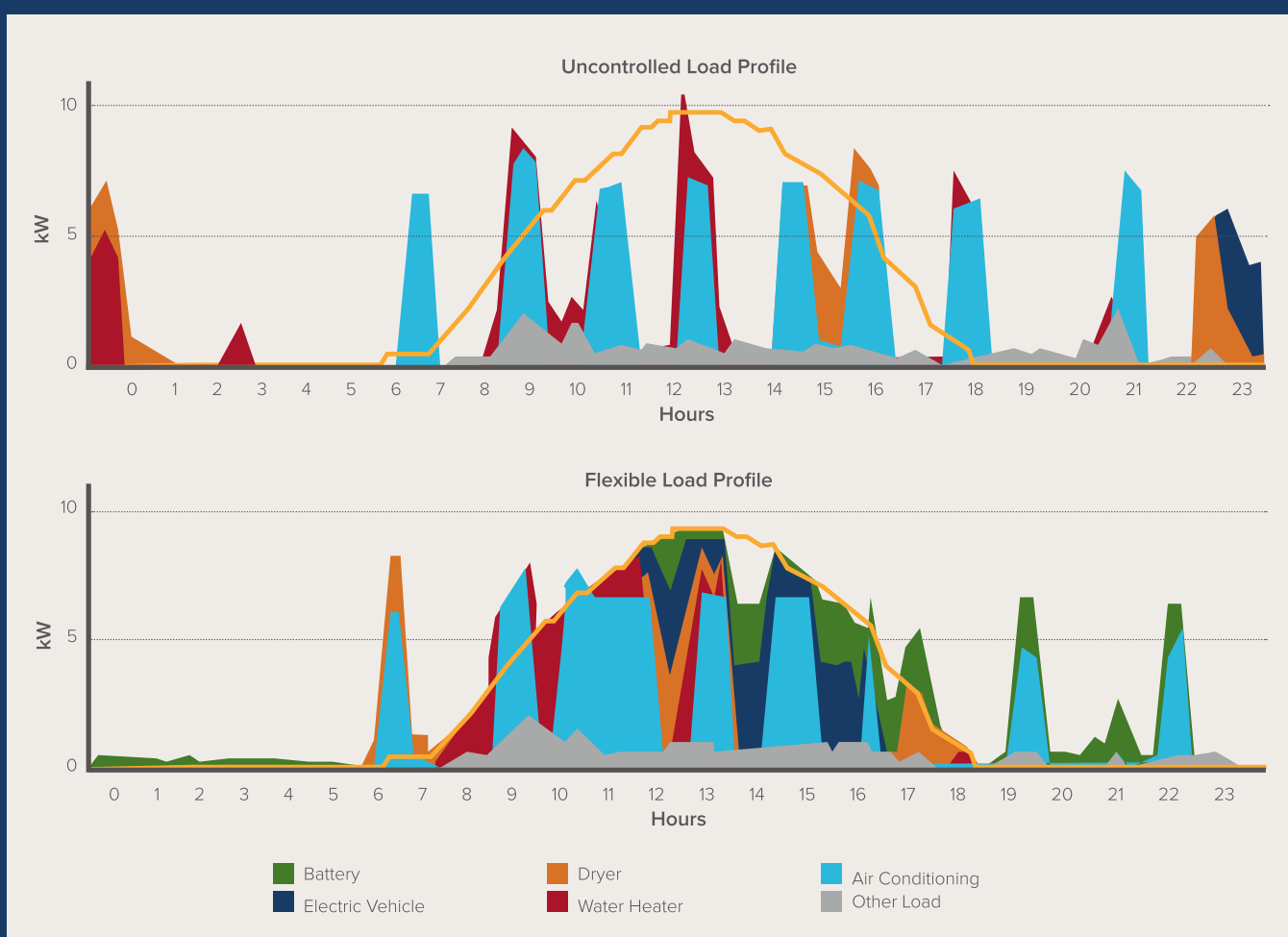
Many factors could improve the cost-effectiveness of electrification compared to gas in the future. The purchase price of heat pump devices is expected to decline as the market grows and manufacturers realize economies of scale. The value of electric demand flexibility is likely to increase as variable renewables grow on the system, increasing the price spreads in electricity markets—customers' ability to capture this value with intelligent devices can reduce the lifetime costs of electrification but depends on new rate designs and utility programs. Carbon pricing or other climate policy may impose additional costs on natural gas supply. Or gas commodity prices may change in unpredictable ways in the future.

Electrification already reduces carbon with today's electric grid in all but the most coal-heavy systems. This is true in comparison to not only heating oil and propane, but also to natural gas. Figure 3 illustrates this result, showing emissions reductions in Oakland, Houston, and Providence. Because the electric grid serving Chicago has coal power as its marginal generator most of the year, the short-term impact of electrification increases carbon emissions.[iii] With continued retirement of coal plants, however, the long-term impact is expected to swing in favor of electrification in Chicago and nationally.

SUMMARY OF RECOMMENDATIONS

Electrification of space and water heating presents a viable pathway to deep decarbonization, already reduces carbon in all but the most coal-dominated regions, can support renewable energy integration with the proper control strategies, and is lower cost than fossil fuel alternatives in several key scenarios including new construction and retrofit from propane or heating oil. Even regions that are coal-dominated today are seeing rapid retirement of coal plants, making

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[iii] For a detailed description of our approach to marginal carbon accounting, see page 23.

electrification more attractive. There were almost 7 GW of coal retirements and no new coal plants in 2017,[5] and more than 11 GW of coal plants are scheduled to retire in 2018.[6] However, many households currently heated with natural gas will not find it cost-effective to switch from furnaces to electric heat pumps at today's prices. To capture the near-term benefits of fuel switching where most beneficial, and to prepare for a long-term approach that includes widespread cost-effective electrification, we offer five recommendations for regulators, policymakers, and utilities:

1. **Prioritize rapid electrification of buildings currently using propane and heating oil** in space and water heating. Although these represent less than 10% of US households, they account for more than 20% of space and water heating emissions. Electrification is very cost-effective for propane customers, and has a comparable cost to heating oil depending on local pricing. Electrifying these homes in the near term can build scale and market maturity to support even more widespread electrification in the future.

2. **Stop supporting the expansion of the natural gas distribution system, including for new homes**. This infrastructure will be obsolete in a highly electrified future, and gas ratepayers face significant stranded asset risk in funding its expansion today. Furthermore, electrification is a lower-cost and lower-carbon solution than extending natural gas, either to new or existing homes.

3. **Bundle demand flexibility programs, new rate designs, and energy efficiency with electrification initiatives** to effectively manage peak load impacts of new electricity demand, especially in colder climates that will see increased peaks in winter electricity demand with electrified heating.

4. **Expand demand flexibility options for existing electric space and water heating loads**. Only 1% of the 50 million existing electric water heaters in the US participate in demand response. As widespread electrification adds loads, particularly in winter, effective demand management will mitigate system costs and aid renewables integration.

5. **Update energy efficiency resource standards and related goals**, either on the basis of total energy reduction across both electricity (in kWh) and gas (in therms), or on the basis of emissions reductions across both electric and gas programs. Otherwise, successful electrification could penalize utilities for not reducing electricity demand, even when it provides cost and carbon benefits.

FIGURE 3

ANNUAL CARBON EMISSIONS BY SCENARIO (THOUSAND LB. CO_2)

NEW CONSTRUCTION **RETROFIT**

OAKLAND

	New Construction	Retrofit
Standard Heat Pump	2.5	5.3
Flexible Heat Pump Default Time-of-Use (TOU) Rate	2.5	5.2
Flexible Heat Pump 3:1 TOU	2.6	5.2
Natural Gas with Existing Air Conditioner (AC)	not applicable	7.6
Natural Gas with New AC	3.2	7.4

HOUSTON

	New Construction	Retrofit
Standard Heat Pump	7.0	13.1
Standard Heat Pump "Free Nights" Electricity Rate	7.0	13.1
Flexible Heat Pump "Free Nights" Electricity Rate	8.5	16.1
Natural Gas with Existing AC	not applicable	15.2
Natural Gas with New AC	8.0	14.4

PROVIDENCE

	New Construction	Retrofit
Standard Heat Pump	4.5	8.2
Natural Gas with Existing AC	not applicable	12.3
Natural Gas with New AC	6.8	12.1
Heating Oil	9.5	17.4
Propane	7.8	13.9

CHICAGO

	New Construction	Retrofit
Standard Heat Pump	14.1	27.1
Natural Gas with Existing AC	not applicable	17.3
Natural Gas with New AC	9.6	16.8

■ Electricity
■ Natural Gas
■ Heating Oil/Propane

BUILDING ELECTRIFICATION AND DECARBONIZATION

US buildings' on-site use of fossil fuels contributes 560 million tons of CO_2 emissions annually, nearly 10% of total national greenhouse gas emissions.[7] Meanwhile, 14 US states have formally committed to deep decarbonization reductions of 75% or greater by mid-century in order to support global efforts to limit average temperature increase to 2°C.[8] Reaching these aggressive state goals will require drastic reductions across all sectors, including buildings' fossil fuel use. Multiple studies have identified the electrification of buildings (along with transportation and many industrial end uses) combined with decarbonization of power generation as critical to achieving these deep decarbonization targets.[9] Moving the US electricity system to power generation that emits zero carbon will only reduce total US emissions 30%. Widespread electrification of buildings, ground transportation, and half of industry would boost reductions to more than 70% if powered by zero-carbon electricity. Even deeper reductions will require additional efficiency improvements or other reductions in remaining industrial end uses, agriculture, air travel, and shipping.[10]

FIGURE 4

CARBON EMISSIONS OF FOSSIL FUEL END USES IN US BUILDINGS, 2015, MT CO_2E
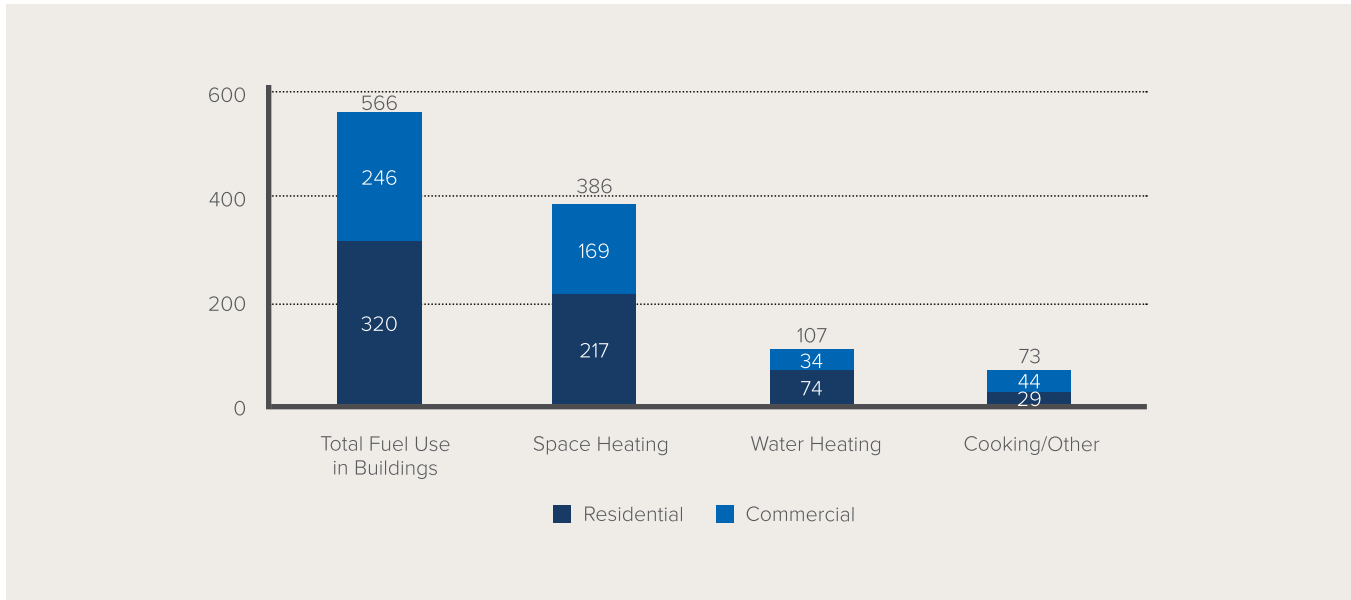
FIGURE 5

US ECONOMY-WIDE GREENHOUSE GAS EMISSIONS AND DECARBONIZATION OPTIONS, MT CO_2E[11]
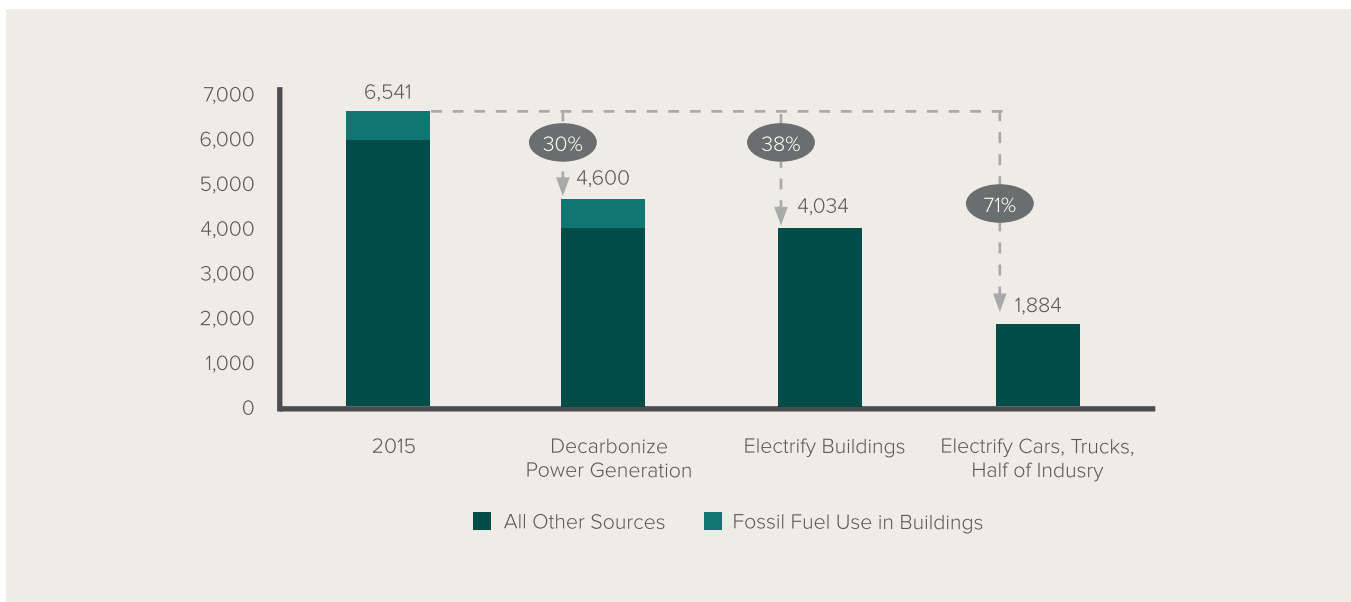
OVERVIEW OF SCENARIO ANALYSIS

- We modeled one year of energy use for water heating, space heating, and air conditioning in a single-family home to determine the annual carbon impact and the 15-year net present cost of each scenario. Our 34 scenarios differed by the variables described in Figure 6.

HEAT PUMP TECHNOLOGY

Heat pumps use electricity to heat and cool buildings. In summer, they operate as air conditioners, moving heat from inside a building to outside. In winter, they operate in reverse, moving heat from outside to inside. Because they move heat rather than generate heat, heat pumps are more efficient than electric furnaces and baseboard heating.[12] More than 12 million US households already use heat pumps as their primary source of heat, mostly in the Southeast.[13] In years past, heat pumps were only effective in mild climates, unable to operate at temperatures below freezing. Today hundreds of models can operate efficiently at 5°F, and some can provide heat in temperatures as low as -13°F.[14] In this report we evaluate air-source heat
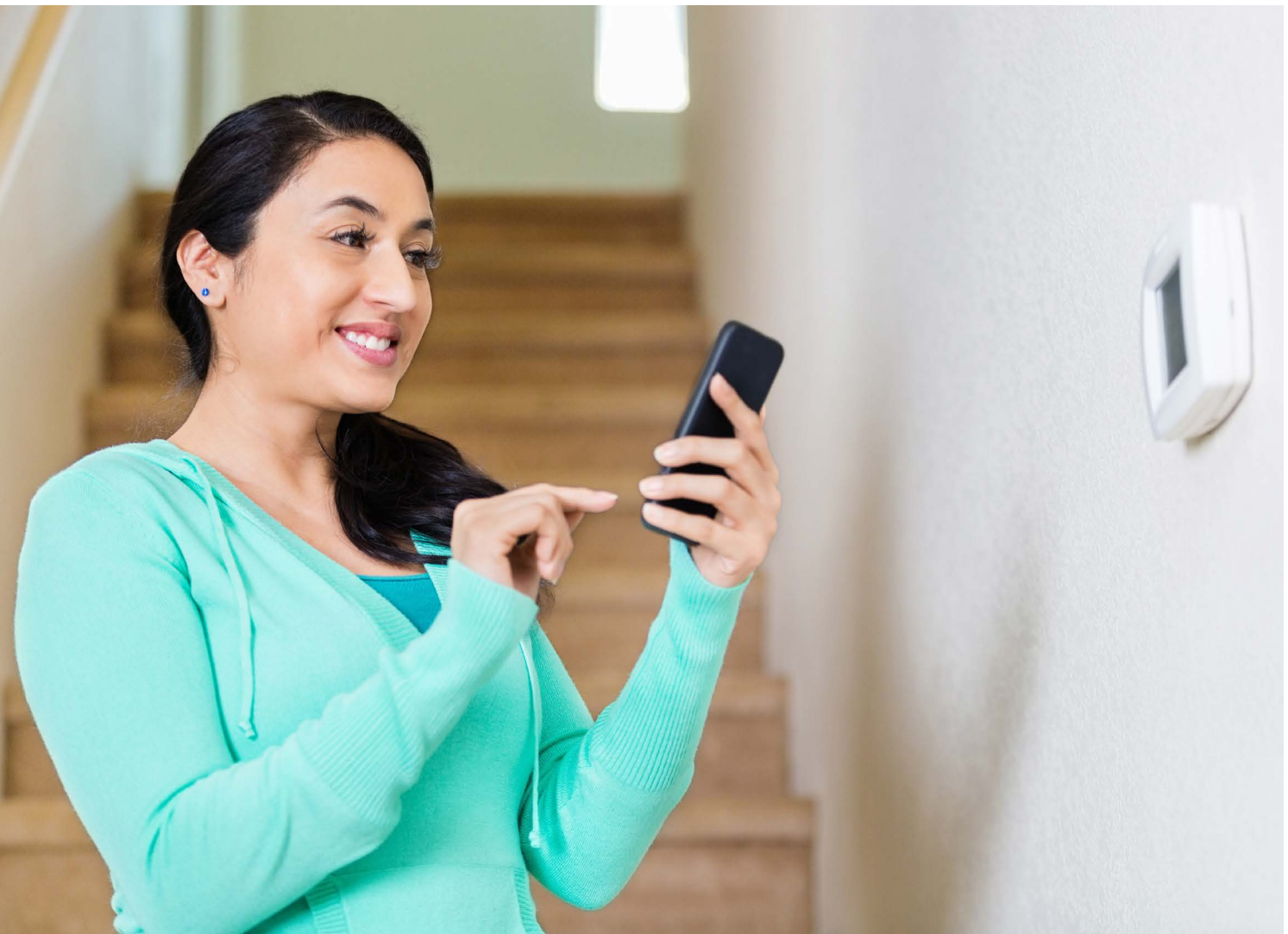
FIGURE 6

SCENARIO CHARACTERISTICS

GEOGRAPHY
Four geographies with a range of climates, electric generation mixes, and electricity markets

Chicago, IL   Oakland, CA   Houston, TX   Providence, RI

HOME TYPE
High-efficiency new construction homes vs. retrofit of lower-efficiency homes

New Construction   Retrofit

RATE
Standard, flat electricity rates vs. time-of-use (TOU) rates where available

$ Time of Day $ Time of Day

Standard Rates   Time-Varying Rates

APPLIANCE
For fossil fuel scenarios, replacement of both a furnace and air conditioner vs. replacement of only a furnace

Replacing Furnace and Air Conditioner   Replacing Only Furnace

FUEL
Electric heat pump, natural gas, propane, and heating oil

Electricity (Heat Pump)   Natural Gas   Propane   Heating Oil

pumps capable of providing central air conditioning and heating. Several other technologies that can also provide efficient electric heat but were not evaluated in this report include the following:

- **Ductless mini-split heat pumps** are air-source heat pumps that heat and cool a single room, rather than an entire home through ducts. Mini-splits can be good solutions for homes without central heating and air conditioning. Cold climate mini-splits have already seen success in electrification programs in the Northeastern US, with more than 70,000 units installed.[15]

- **Ground-source heat pumps**, also called geothermal heat pumps, exchange heat with the ground rather than the air surrounding a building. This is advantageous in cold climates, where the ground temperature remains moderate even when the air temperature is very cold, and ground-source heat pumps consume less energy on the coldest days in particular. Ground-source heat pumps have historically been significantly more expensive than air-source heat pumps due to the need for drilling and underground equipment installation, but new innovation in this market may make these devices more cost-effective in the near future.[16]

- **CO_2 refrigerant heat pumps** use carbon dioxide in place of traditional refrigerants like R-410a. These systems are highly efficient and avoid the use of HFC refrigerants, which have high global warming impacts if leaked. While common in Japan and Southeast Asia, these systems do not yet have a significant US market presence.[17]

- **Efficient low-lift heat pumps** have been shown to achieve heating coefficients of performance as high as 9. The term "low-lift" refers to the temperature difference between the source (e.g., outside air or underground) and the space or water that is being heated. Swiss researchers demonstrated technology that used deep (300 meters or greater) underground probes combined with efficient underfloor heating systems to provide a temperature lift of 20°C (36°F), from a deep underground source at 46°F to heat water to 82°F for underfloor heating.[18]

FINDINGS

COST-EFFECTIVENESS OF ELECTRIFICATION

Electrifying buildings is cost-effective today in some scenarios, but more expensive for most existing natural gas customers. While costs can vary substantially depending on individual home characteristics, our analysis found several consistent results. Electrification is generally cost-effective for oil and propane customers, for both new construction and retrofits. For newly constructed homes, heat pumps are usually the lowest-cost option, particularly since a heat pump provides both heating and air conditioning, and these homes avoid the cost of both furnaces and air conditioners. For retrofits of existing homes, heat pumps can be lower cost than replacing both furnace and air conditioner separately. For homes currently using natural gas heating and only needing to replace a gas furnace, it is usually more expensive to electrify than to stick with gas. Demand flexibility that optimizes for typical time-of-use rates can reduce energy costs, but is not usually significant enough to tip the scales in favor of electrification. Different pricing structures that capture more of these devices' flexible capability could provide much greater value and further improve customer economics. The costs presented in Figure 7 include space heating, water heating, and air conditioning, and are presented on the basis of 15-year net present cost.

CARBON IMPACTS OF ELECTRIFICATION

Electrification already reduces carbon with today's technology and electric grid in all but the most coal-heavy regions.[iv] In decades past, building electrification meant installing inefficient electric resistance devices or older heat pumps that performed poorly at cold temperatures, powered by a coal-dominated grid. Between the inefficiency of the devices and the high carbon intensity of the power generation, heating with electricity was dirtier and more expensive than burning natural gas on site. But now, efficient modern heat pumps combined with a lower-carbon grid have created a new opportunity to decarbonize with electrification.

In Houston, Oakland, and Providence, heat pump systems produce less carbon emissions than natural gas systems today. When compared to heating oil and propane in Providence, the carbon savings from fuel switching are even more dramatic. Because Chicago's grid is largely coal-fired on the margin, at least in the short term, heat pump systems currently have higher emissions than natural gas systems. With the continued pace of coal plant retirement, we expect this to change in favor of electrification. Reciprocally, in regions that already have a relatively low-carbon generation mix—such as Rhode Island, where the marginal emissions intensity averages 815 lb./MWh—heat pump systems are significantly less carbon intensive than natural gas.

Note that we include air conditioning loads in our analysis, even though they are already electrified. This is because heat pumps function as both air conditioners and heaters, and often provide air conditioning at very high efficiency relative to existing AC systems. Customers facing the prospect of replacing both an air conditioner and furnace can save installation cost by choosing a heat pump for both functions, and often reduce carbon further due to the efficiency improvement in air conditioning the heat pump provides.

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iv For more detail on our carbon analysis and an assessment of the effects of methane leakage, see page 26.

FIGURE 7

COMPARISON OF 15-YEAR NET PRESENT COSTS OF WATER HEATING AND SPACE CONDITIONING (THOUSAND $)

NEW CONSTRUCTION   RETROFIT

OAKLAND

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump	$11.5	$22.9
Flexible Heat Pump Default Time-of-Use (TOU) Rate	$11.8	$22.9
Flexible Heat Pump 3:1 TOU	$10.9	$20.8
Natural Gas with Existing Air Conditioner (AC)	not applicable	$16.1
Natural Gas with New AC	$13.7	$24.2

HOUSTON

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump	$11.5	$19.0
Standard Heat Pump "Free Nights" Electricity Rate	$13.1	$23.5
Flexible Heat Pump "Free Nights" Electricity Rate	$12.3	$22.4
Natural Gas with Existing AC	not applicable	$15.2
Natural Gas with New AC	$15.1	$21.4

PROVIDENCE

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump	$14.3	$25.6
Natural Gas with Existing AC	not applicable	$17.9
Natural Gas with New AC	$16.6	$24.1
Heating Oil	$20.9	$26.9
Propane	$28.0	$39.2

CHICAGO

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump	$9.6	$19.3
Natural Gas with Existing AC	not applicable	$12.8
Natural Gas with New AC	$13.6	$19.2

- Electricity
- Natural Gas
- Heating Oil/Propane

FIGURE 8

ANNUAL CARBON EMISSIONS BY SCENARIO (THOUSAND LB. CO_2)

OAKLAND

NEW CONSTRUCTION	RETROFIT
Standard Heat Pump	2.5	5.3
Flexible Heat Pump Default Time-of-Use (TOU) Rate	2.5	5.2
Flexible Heat Pump 3:1 TOU	2.6	5.2
Natural Gas with Existing Air Conditioner (AC)	not applicable	7.6
Natural Gas with New AC	3.2	7.4

HOUSTON

Standard Heat Pump	7.0	13.1
Standard Heat Pump "Free Nights" Electricity Rate	7.0	13.1
Flexible Heat Pump "Free Nights" Electricity Rate	8.5	16.1
Natural Gas with Existing AC	not applicable	15.2
Natural Gas with New AC	8.0	14.4

PROVIDENCE

Standard Heat Pump	4.5	8.2
Natural Gas with Existing AC	not applicable	12.3
Natural Gas with New AC	6.8	12.1
Heating Oil	9.5	17.4
Propane	7.8	13.9

CHICAGO

Standard Heat Pump	14.1	27.1
Natural Gas with Existing AC	not applicable	17.3
Natural Gas with New AC	9.6	16.8

■ Electricity
■ Natural Gas
■ Heating Oil/Propane

APPROACHES TO QUANTIFYING CARBON EMISSIONS

Our analysis uses a short-term marginal carbon approach. Here we discuss the merits of that approach compared to two alternatives: average carbon and long-term marginal carbon.

SHORT-TERM MARGINAL CARBON:

This approach, used throughout this report, considers what generator is "on the margin" in a particular system in each 15-minute increment for a year.[v] This marginal generator is the power plant that must increase its output if demand increases. In Chicago, the dominant marginal generation throughout the year is coal, producing around 2,166 lb. CO_2/kWh. So, a new electric heating load would have the effect of increasing immediate output from these coal plants and adding emissions accordingly.

This approach has the benefit of considering the changes that load growth has on the grid rather than considering the generation that would take place regardless of changes in load (as in the average carbon approach). However, it does have drawbacks. First, it does not consider changes in the grid over time, namely that coal plants are retiring around the country, and the grid that future heat pumps will draw from will look different than the grid in 2016. And second, this short-term approach does not consider how increases in load, especially those with demand flexibility that can coincide with periods of high wind or solar output, affect decisions about what resources to add to the system.

FIGURE 9

COMPARISON OF SHORT-TERM MARGINAL ANNUAL CARBON EMISSIONS IN CHICAGO, RETROFIT (THOUSAND LB. CO_2)

SHORT-TERM MARGINAL

Standard Heat Pump	27.1
Natural Gas	17.3

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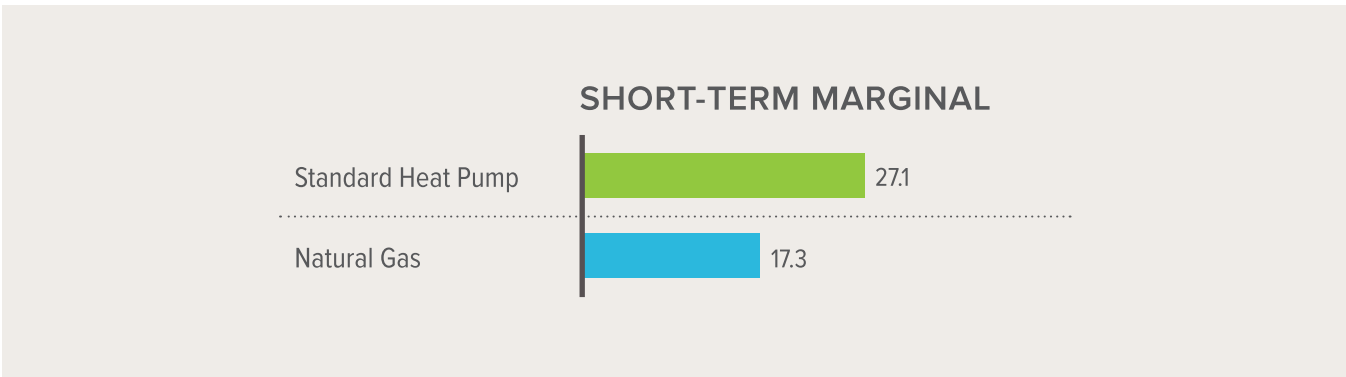
[v] Our data comes from WattTime and reflects actual 2016 grid operations in each geography.

AVERAGE CARBON:

This approach applies the average carbon intensity of a state's grid to the increase in load from electrification. The drawback of this approach is that it reflects the generation that already exists without electrification rather than considering the impact of added load. Therefore it does not reflect the actual emissions resulting from new heat pump loads. In Illinois, for example, the average carbon intensity—848 lb./MWh, reflecting a mix of natural gas, coal, and renewables—would suggest heat pumps are significantly less carbon-intensive than natural gas systems.

FIGURE 10

COMPARISON OF ANNUAL AVERAGE CARBON EMISSIONS IN CHICAGO, RETROFIT (THOUSAND LB. CO_2)

AVERAGE

Standard Heat Pump 10.7

Natural Gas 17.3
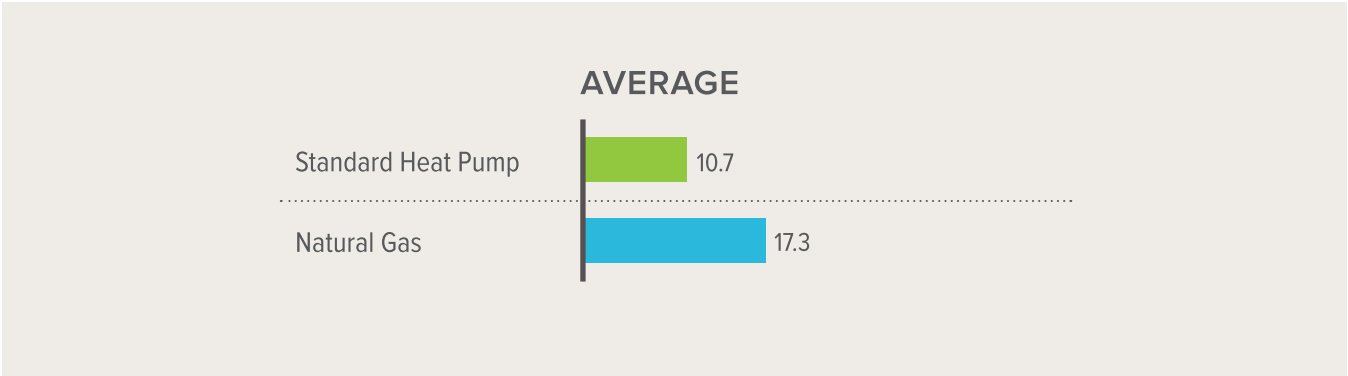
LONG-TERM MARGINAL CARBON:

This approach considers both which plants must increase their output immediately in response to new load, and the long-term changes in plants' capacity factors, retirement schedules, and additions of new generation in response to load growth. The long-term marginal carbon approach was beyond the scope of this study.

However, as an illustrative hypothetical, we consider the following scenario for Chicago: that some coal plants increase capacity factor immediately or delay retirement in response to load growth, but that many still retire, while increased load is met by natural gas and wind. While the carbon impact in the first year would be coal-heavy, in future years the addition of new gas and wind generation to meet load growth would come into play. The long-term carbon impact can be conveyed as the combined impact of these factors over a 15-year lifetime of the devices. For our hypothetical, we assume this combined impact is equal parts coal, natural gas, and wind, resulting in a beneficial outlook for electrification, as shown in Figure 11.

FIGURE 11

COMPARISON OF LIFETIME LONG-RUN MARGINAL CARBON EMISSIONS IN CHICAGO, RETROFIT (THOUSAND LB. CO_2)

LONG-RUN MARGINAL

Standard Heat Pump — 194.0
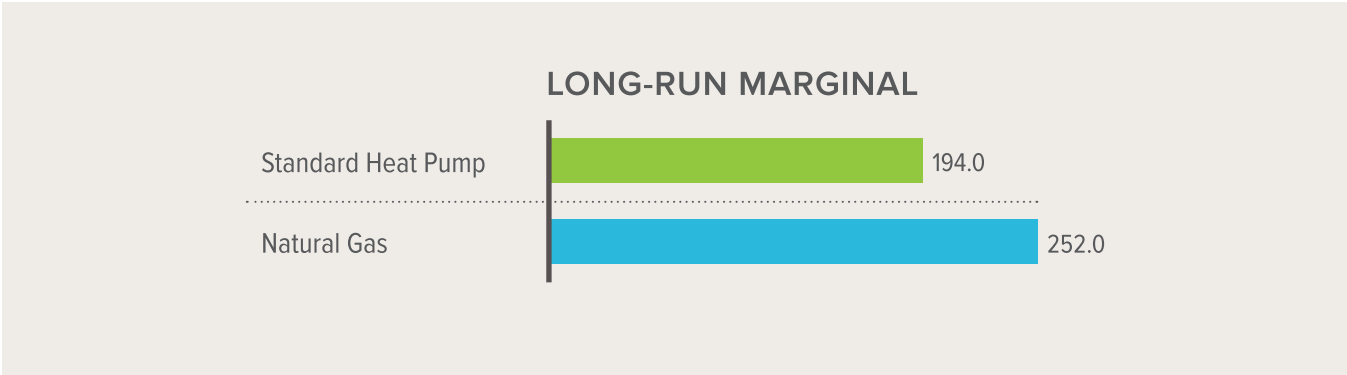
Natural Gas — 252.0

METHANE LEAKAGE

Natural gas, composed primarily of methane, is a powerful greenhouse gas if emitted directly into the atmosphere, driving 85 times more warming than carbon dioxide over a 20-year period.[19] The production and distribution of natural gas is known to leak methane, increasing the global warming impact of natural gas beyond the value typically considered in gas combustion, whether in a power plant, furnace, or water heater. We account for that impact here, using leakage estimates ranging from 2%, EPA's 2016 estimate, to 3.8%, from Robert Howarth's research at Cornell.[20]

In Chicago, the prevalence of coal plants as marginal generators suggests that electrification is significantly more carbon intensive than natural gas systems. However, accounting for methane emissions significantly increases the emissions impact of natural gas systems in relation to coal emissions. Due to the increased emissions of natural gas systems with methane leakage, heat pump systems in Chicago now have comparable emissions impacts to natural gas use in the home. Heat pumps range from 12% more carbon intensive to 11% less carbon intensive than natural gas systems, depending on the leakage rate used.

FIGURE 12

ANNUAL EMISSIONS OF HEATING IN CHICAGO RETROFIT WITH METHANE LEAKAGE (THOUSAND LB. CO_2E)

RETROFIT

Standard Heat Pump — 27.1
Natural Gas with Existing AC — 17.3, 10.1
Natural Gas with New AC — 16.8, 10.1

- Heat Pump Emissions
- Natural Gas Combustion Emissions
- Methane Emissions
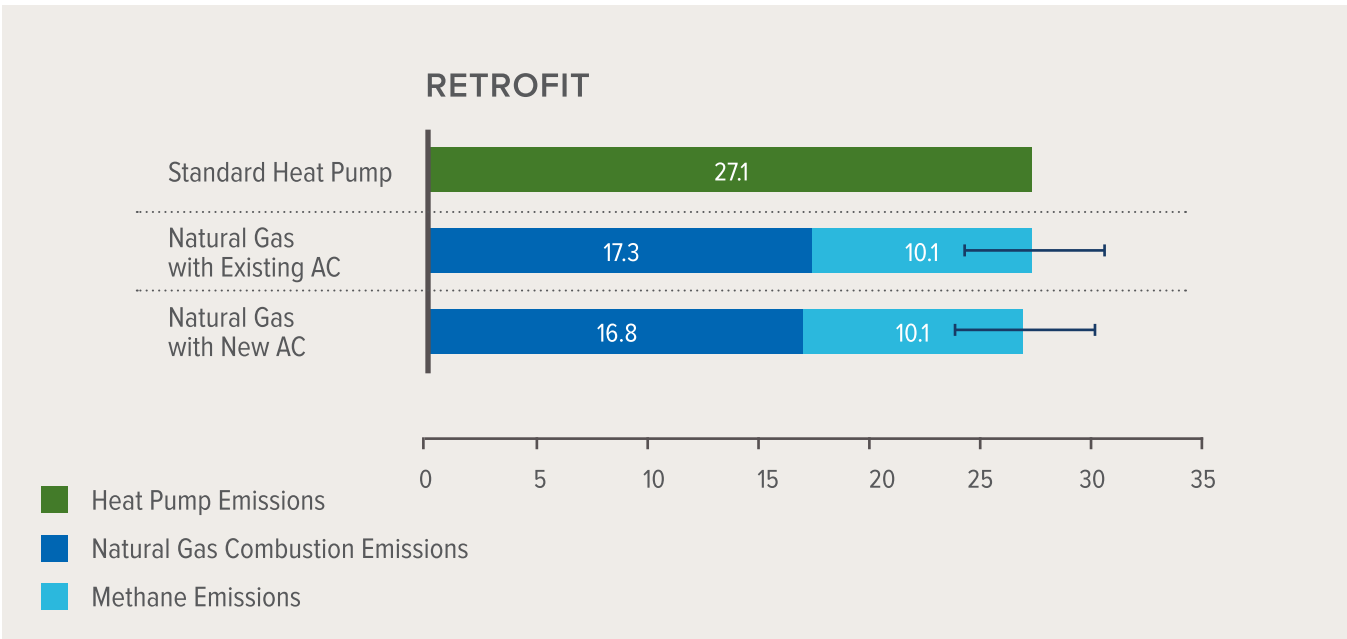
In other geographies, we conservatively assume that the marginal unit on the electric grid is entirely natural-gas fired, based on approximation of system emissions data. Because additional emissions from methane leakage are proportional to emissions from natural gas, incorporating methane leakage does not change which scenarios are more or less carbon intensive.

However, the carbon-intensive oil and propane systems used in the Northeast do not have methane leakage. When accounting for methane emissions in Providence, propane becomes slightly more attractive than natural gas. Heating oil, however, remains the most carbon-intensive fuel option, and heat pumps remain the least.

FIGURE 13

ANNUAL EMISSIONS OF HEATING IN PROVIDENCE RETROFIT WITH METHANE LEAKAGE (THOUSAND LB. CO_2E)

RETROFIT

Standard Heat Pump	8.2 / 7.4
Natural Gas with Existing AC	12.3 / 11.1
Natural Gas with New AC	12.1 / 10.9
Heating Oil with Existing AC	17.2 / 3.1
Propane with Existing AC	13.9 / 3.1

Legend:
- Heat Pump Emissions
- Methane Emissions
- Natural Gas Combustion Emissions
- Methane Emissions
- Oil/Propane Combustion Emissions
- Methane Emissions
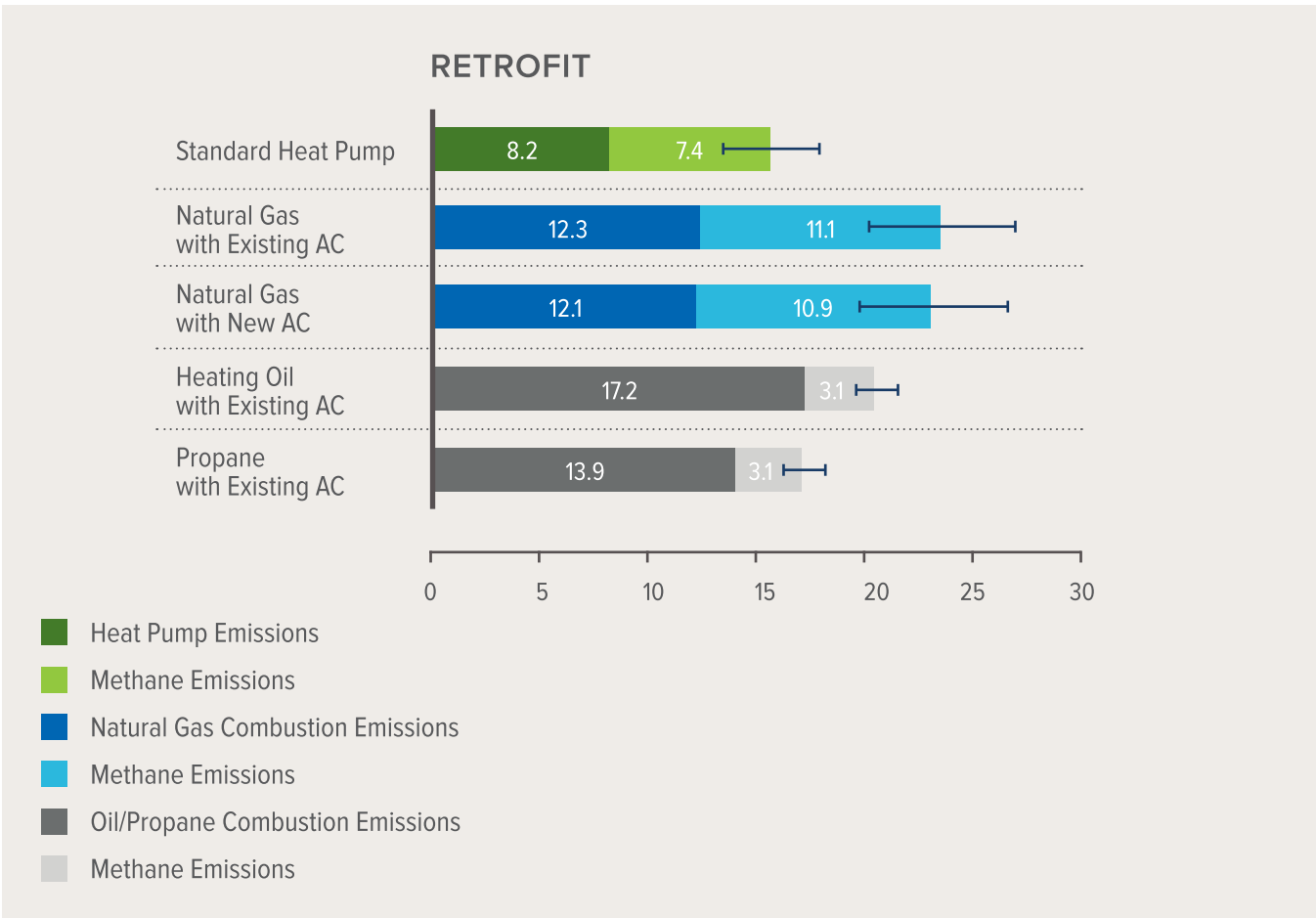
A CLOSER LOOK: GEOGRAPHIES IN DETAIL

We assessed results in four cities: Oakland, California; Houston, Texas; Providence, Rhode Island; and Chicago, Illinois. In each geography, we compared the lifetime cost and carbon impacts of natural gas and heat pump systems in both new construction and retrofit homes. Because each geography is unique in terms of predominant fuel types, climate, and electricity rates, we considered additional scenarios for certain geographies. In Providence, we also compared heating oil and propane systems, as many homes in the Northeast use these fuels rather than natural gas. For time-varying rates in Oakland and Houston, we also compared flexible devices optimizing for energy costs in response to these rates.

In this section, we highlight the nuances of these different scenarios and offer some geographically specific recommendations and opportunities.

RESULTS: OAKLAND, CA

In Oakland, heat pumps produce universally less carbon emissions compared to natural gas systems, and they are cost-effective in many scenarios.

For newly constructed buildings, heat pumps are universally more cost-effective, even without optimizing for demand flexibility, primarily because the

FIGURE 14
NET PRESENT COST OF WATER AND SPACE CONDITIONING, OAKLAND (THOUSAND $)

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump Default TOU	$4.7 $6.8 $11.5	$11.6 $11.3 $22.9
Flexible Heat Pump Default TOU	$4.7 $7.1 $11.8	$11.2 $11.6 $22.8
Flexible Heat Pump 3:1 TOU	$3.8 $7.1 $10.9	$9.2 $11.6 $20.8
Natural Gas with Existing AC	not applicable	$11.1 $5.0 $16.1
Natural Gas with New AC	$4.3 $9.5 $13.8	$11.6 $12.5 $24.1

- ■ Heat Pump Energy Costs
- ■ Heat Pump Fixed Costs
- ■ Natural Gas Energy Costs
- ■ Natural Gas Fixed Costs

FIGURE 15

ANNUAL MARGINAL CARBON EMISSIONS IN OAKLAND (THOUSAND LB. CO_2)

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump Default TOU	1.3 / 1.2 / 2.5	4.1 / 1.2 / 5.3
Flexible Heat Pump Default TOU	1.3 / 1.2 / 2.5	3.9 / 1.2 / 5.2
Flexible Heat Pump 3:1 TOU	1.3 / 1.3 / 2.6	3.9 / 1.3 / 5.2
Natural Gas with Existing AC	not applicable	5.7 / 1.9 / 7.6
Natural Gas with New AC	1.3 / 1.9 / 3.2	5.5 / 1.9 / 7.4

■ Heat Pump Space Conditioning
■ Heat Pump Water Heating
■ Natural Gas Space Conditioning
■ Natural Gas Water Heating
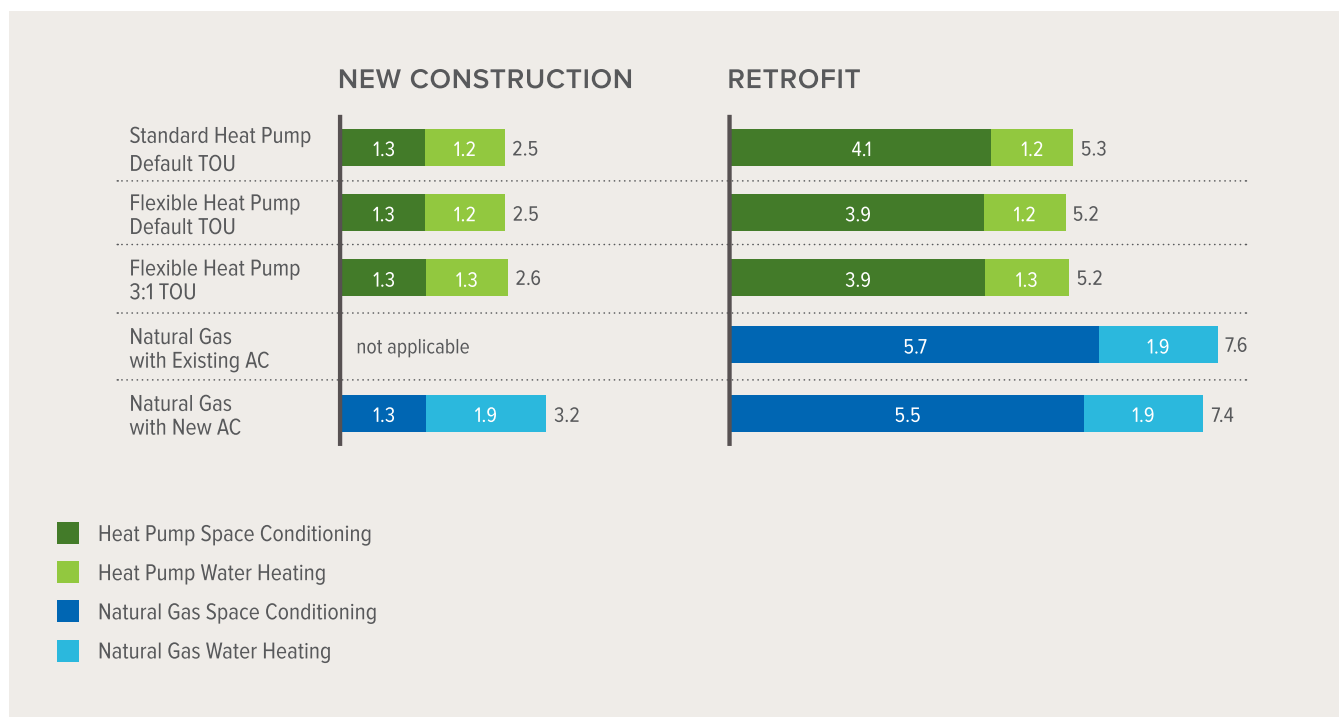
heat pump provides both heating and air conditioning, avoiding the need to purchase both a furnace and an air conditioner. In Oakland, we consider two time-of-use rates. The default TOU represents the rate structure that most California residential customers will experience starting in 2019. Because nearly all customers will be enrolled on this TOU rate by default, we do not evaluate a flat electric rate. Because this default rate has relatively mild price differentials (only up to 20% price premium for peak periods), we also evaluated a representative 3:1 TOU rate as an illustrative example of a rate with increased price differentials, like some of PG&E's opt-in rates.[vi]

The flexible device on the 3:1 rate offers the most lifetime savings as it optimizes for demand flexibility

by strategically preheating or precooling space and water, saving nearly $1,000 in lifetime energy costs compared to an inflexible device on the standard rate. The default TOU rate has too small a price differential (at most, peak pricing is 19% greater than off-peak pricing) to encourage significant load shifting or to capture significant savings, and it may not recoup the added cost of equipping the devices with extra control capability to operate flexibly.

In retrofit buildings, heat pumps are more expensive than simply replacing a gas furnace and water heater. While natural gas remains the cheapest option, optimizing for demand flexibility with a hypothetical 3:1 TOU rate makes a heat pump system more cost-effective, saving more than $2,000 over a standard,

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[vi] The 3:1 TOU rate is a representative time-of-use rate where peak pricing is three times as expensive as off-peak pricing.

non-optimized heat pump. However, if a household is simultaneously replacing both an air conditioner and natural gas space and water heating systems, it is more cost-effective to electrify; rather than paying for an air conditioner, furnace, and water heater, households can purchase just two devices: an air-source heat pump and heat pump water heater. The flexible devices on the default TOU have a slightly higher cost than a standard device; the savings possible from demand flexibility are too small to overcome the increased device costs to enable demand flexibility.

Building electrification already reduces carbon in California with today's grid, and this carbon benefit will increase as California's grid continues to decarbonize. In all scenarios, heat pump systems produce significantly less carbon emissions than natural gas systems; retrofit households with heat pumps would emit 2,000 fewer pounds of carbon per year than natural gas systems. This is true even based on today's marginal generation mix, which averages about 1,000 lb. CO_2/MWh. As California's grid becomes increasingly renewable in response to the state's mandate for 50% renewable energy by 2030, the long-term impact of adding electricity demand will drive significant new renewable generation.

Notably, new construction homes have less than half the carbon footprint as the less-efficient existing home modeled here, even in Oakland's mild climate.

This reinforces the importance of energy efficiency standards in new building, and of efficiency retrofits in existing buildings, regardless of fuel choice.

Recommendations based on Oakland results

- Recognize and encourage all-electric new construction buildings as both a cost-reducing and carbon-reducing measure through new building codes and incentive programs.

- Limit or stop further expansion of the natural gas distribution system to service more homes. Electric space and water heating is likely to provide the same service to customers for less cost and carbon emissions, and avoid the risk of stranded gas distribution assets.

- Encourage load shifting of space and water heating loads into midday periods of high solar generation, to accommodate California's duck curve—the curve showing the difference in electricity demand and the amount of available solar energy throughout the day. The proposed default TOU rates have insufficient price differentials to encourage significant load shifting for thermal loads. Alternatives include opt-in rates with higher price differentials, utility demand response programs, or procurement of third-party aggregator solutions.

RESULTS: HOUSTON, TX

For new construction, standard heat pumps offer more than $3,500 in lifetime savings as compared to natural gas space and watering heating with an air conditioning system. However, in retrofit buildings, natural gas systems remain cheaper than electrification by a similar margin. For a household facing replacement of both a gas furnace and air conditioning unit, heat pumps can offer significant lifetime savings, more than $2,000 as compared to replacing both devices individually.

Heat pump systems on TXU Energy's "Free Nights" rate, with higher electricity prices during the day and free electricity at nights, have higher costs than heat pumps on a flat rate plan, due to the significant

daytime cooling load in Houston. However, for a customer who does use the Free Nights rate, optimizing heat pumps for demand flexibility saves around $1,000 in net present cost. This includes preheating water overnight and precooling or preheating the home aggressively while electricity is free to reduce consumption during the day.

Standard heat pumps do reduce carbon emissions compared to natural gas in Texas. Natural gas systems are 15% more carbon intensive than heat pump systems in new homes, and 10% more carbon intensive in retrofit homes.

Optimizing for Free Nights can lead to unintended consequences for carbon: flexible devices, optimized to preheat or precool very aggressively during the

NET PRESENT COST OF WATER AND SPACE CONDITIONING, HOUSTON (THOUSAND $)
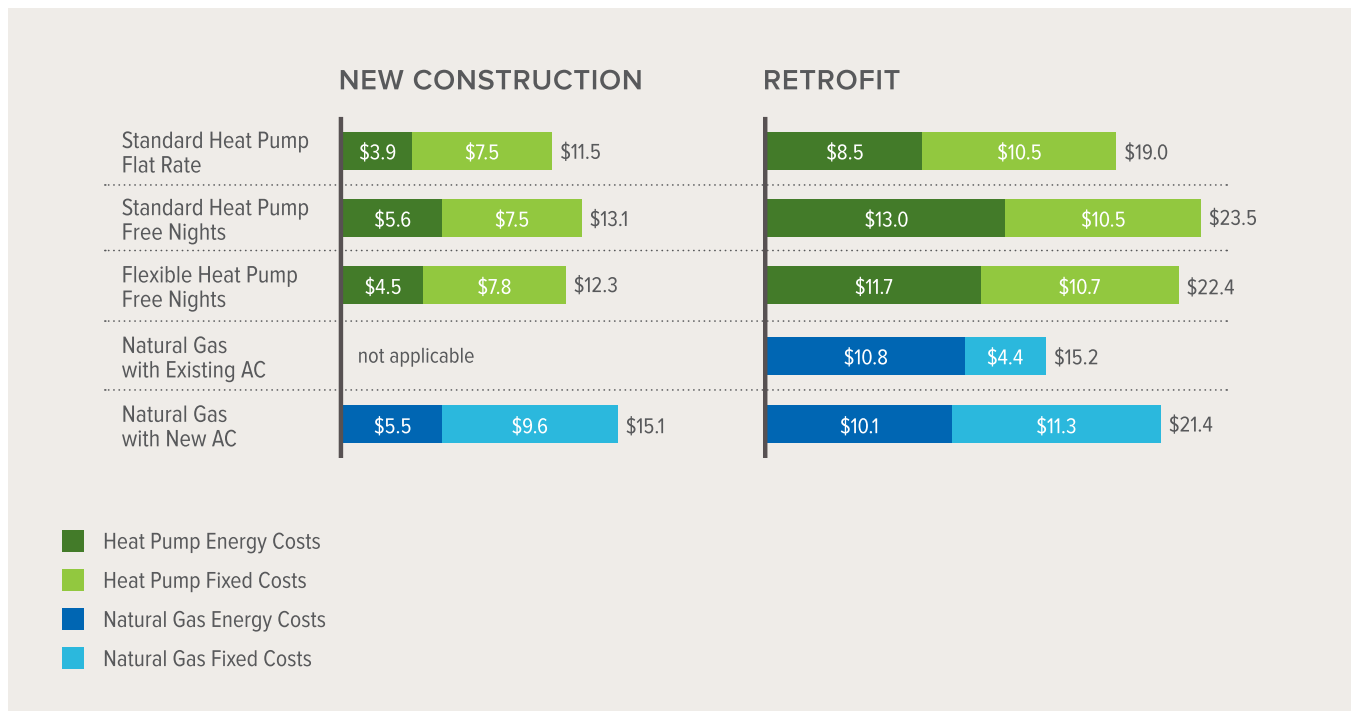
FIGURE 17

ANNUAL MARGINAL CARBON EMISSIONS IN HOUSTON (THOUSAND LB. CO_2)

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump Flat Rate	5.4 / 1.6 / 7.0	11.5 / 1.6 / 13.1
Standard Heat Pump Free Nights	5.4 / 1.6 / 7.0	11.5 / 1.6 / 13.1
Flexible Heat Pump Free Nights	6.3 / 2.2 / 8.5	13.8 / 2.2 / 16.1
Natural Gas with Existing AC	not applicable	13.4 / 1.9 / 15.2
Natural Gas with New AC	6.1 / 1.9 / 8.0	12.5 / 1.9 / 14.4

- Heat Pump Space Conditioning
- Heat Pump Water Heating
- Natural Gas Space Conditioning
- Natural Gas Water Heating

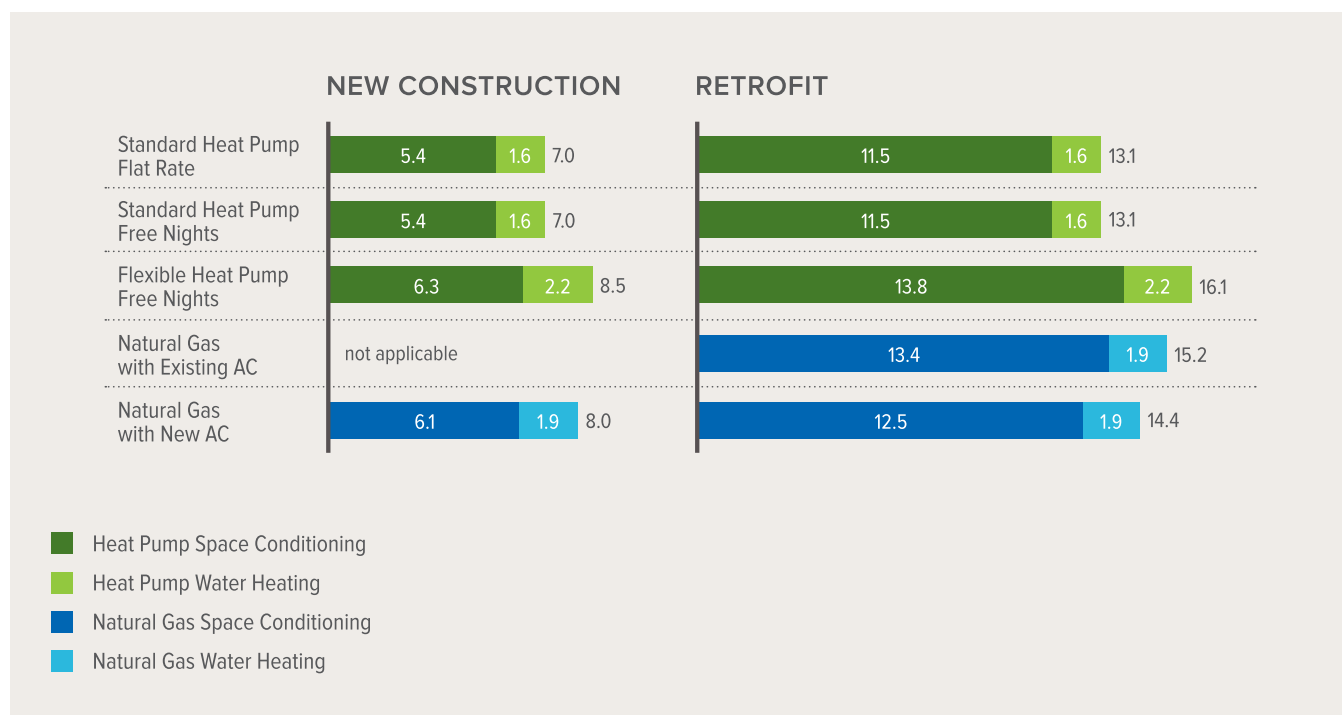night when electricity is free, use much more energy than standard heat pumps. This additional energy use increases emissions, making a flexible heat pump 20% more carbon intensive than a standard heat pump, and 12% more carbon intensive than a natural gas system for a retrofit building. Note that this conclusion applies to the short-term impact of increased nighttime energy use but does not consider the long-term impact of increased nighttime demand, and, for instance, the potential for accommodating more wind power on the Texas grid.

Recommendations based on Houston results

- Retailers can offer new bundled electrification packages, including whole-home electrification and tailored rates or demand response programs

for these customers. Sophisticated offerings could include smart thermostat programs to optimize preheating and precooling based on the market prices the retailer faces while keeping customer comfort within acceptable ranges. Innovative products for environmentally conscious customers could further optimize for integration of wind resources on Texas's grid.

- Combine building efficiency measures with electrification. As in other geographies, energy costs and carbon impacts for efficient new homes are less than half those in inefficient buildings.

RESULTS: PROVIDENCE, RI

In Providence, heat pumps are more cost-effective and reduce carbon emissions in all scenarios, with the exception of retrofits of existing natural gas systems. Electrification offers particularly large carbon and cost savings potential compared to heating oil and propane systems.

For newly constructed homes, heat pumps are the most cost-effective option as compared to all fossil fuels, saving more than $2,000 against the next cheapest option, natural gas.
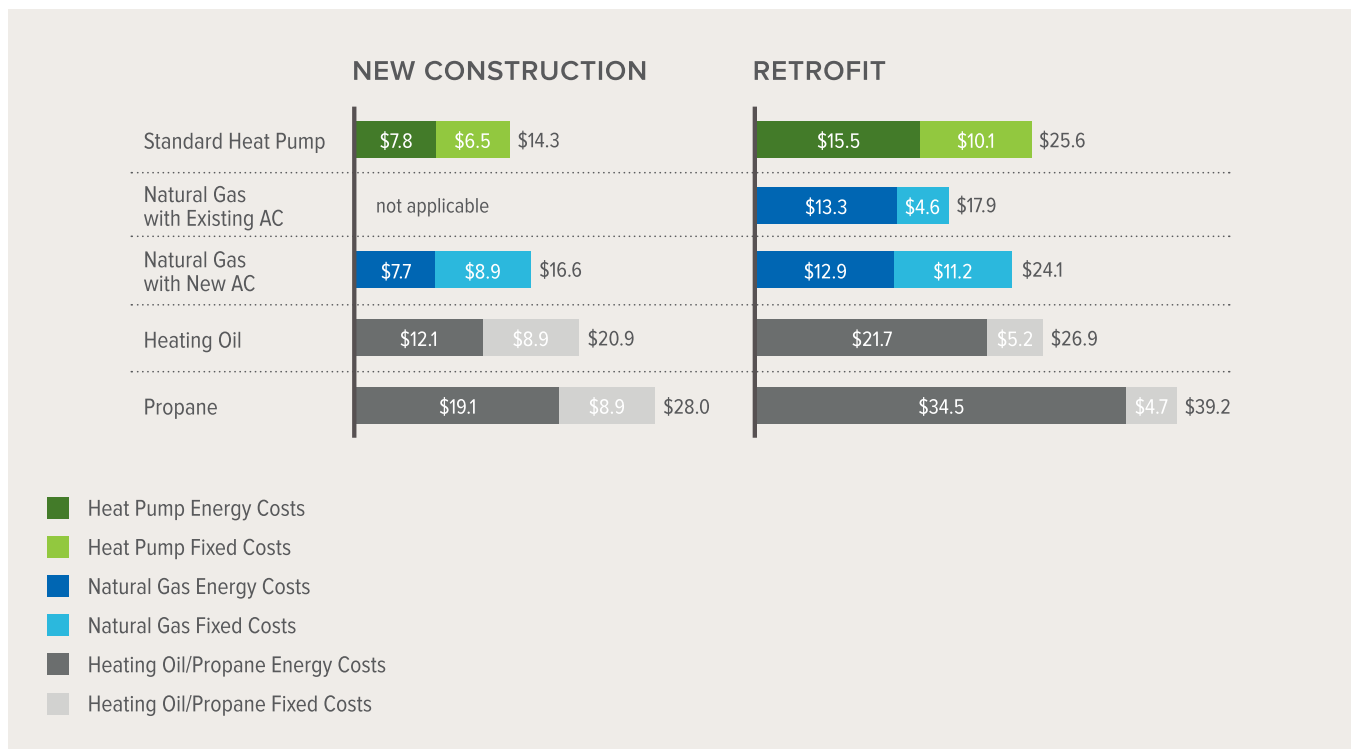
In existing homes, replacing a natural gas furnace and water heater with new gas devices costs less than a
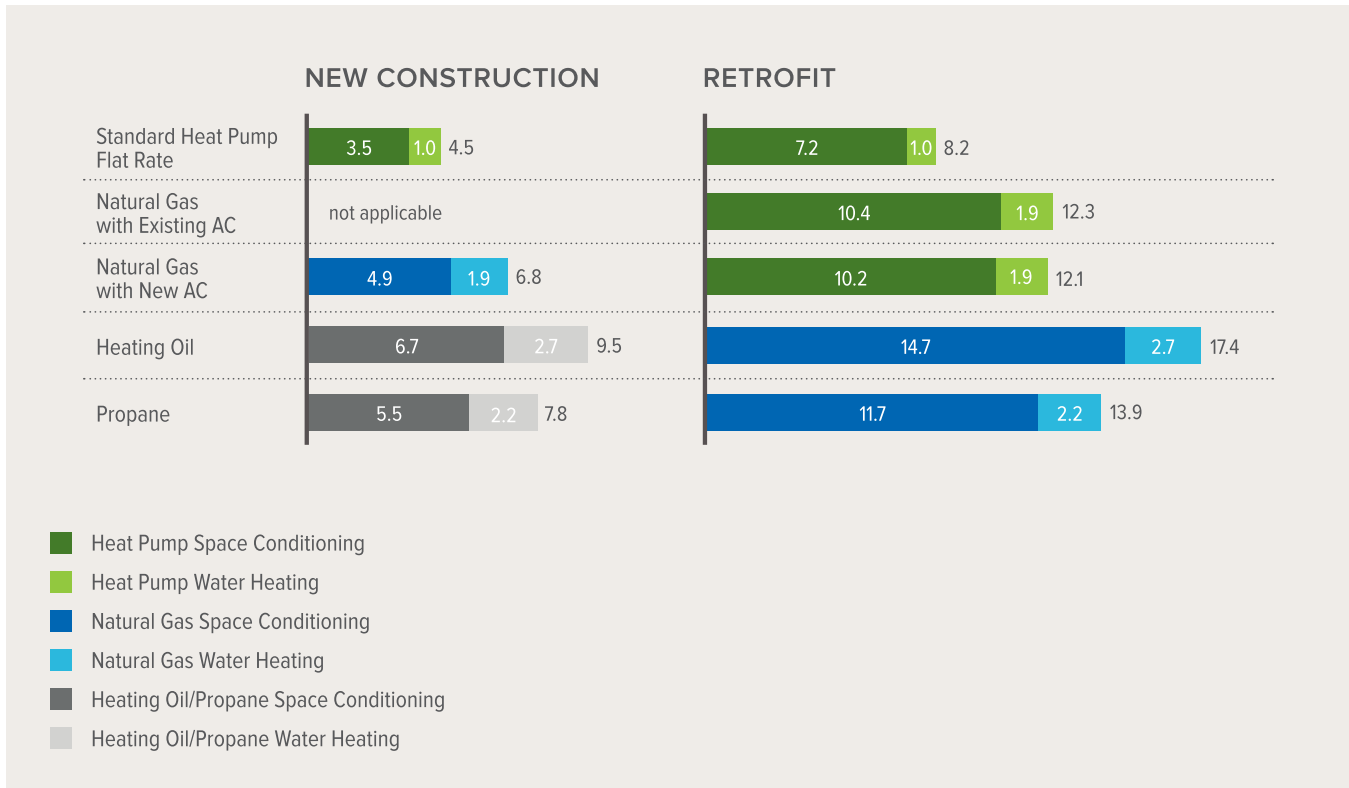
heat pump retrofit, regardless of whether a household is replacing an air conditioner simultaneously. The combination of Rhode Island's cold climate, which reduces the efficiency of heat pump heating performance, and a leaky home results in high electricity usage for heating a retrofit home. Combined with relatively high electricity prices in Rhode Island, this high heating usage makes electrification more costly than natural gas for retrofit homes.

However, many areas in New England lack gas infrastructure and instead rely on heating oil or propane; heat pumps have a lower net present cost than both heating oil- and propane-fired systems. Propane systems are extremely expensive, due to high fuel costs; switching to heat pump systems can

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FIGURE 18

NET PRESENT COST OF WATER AND SPACE CONDITIONING, PROVIDENCE (THOUSAND $)

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump	$7.8 $6.5 $14.3	$15.5 $10.1 $25.6
Natural Gas with Existing AC	not applicable	$13.3 $4.6 $17.9
Natural Gas with New AC	$7.7 $8.9 $16.6	$12.9 $11.2 $24.1
Heating Oil	$12.1 $8.9 $20.9	$21.7 $5.2 $26.9
Propane	$19.1 $8.9 $28.0	$34.5 $4.7 $39.2

- Heat Pump Energy Costs
- Heat Pump Fixed Costs
- Natural Gas Energy Costs
- Natural Gas Fixed Costs
- Heating Oil/Propane Energy Costs
- Heating Oil/Propane Fixed Costs

FIGURE 19

ANNUAL MARGINAL CARBON EMISSIONS IN PROVIDENCE (THOUSAND LB. CO_2)

NEW CONSTRUCTION **RETROFIT**

	New Construction	Retrofit
Standard Heat Pump Flat Rate	3.5 / 1.0 / 4.5	7.2 / 1.0 / 8.2
Natural Gas with Existing AC	not applicable	10.4 / 1.9 / 12.3
Natural Gas with New AC	4.9 / 1.9 / 6.8	10.2 / 1.9 / 12.1
Heating Oil	6.7 / 2.7 / 9.5	14.7 / 2.7 / 17.4
Propane	5.5 / 2.2 / 7.8	11.7 / 2.2 / 13.9

■ Heat Pump Space Conditioning
■ Heat Pump Water Heating
■ Natural Gas Space Conditioning
■ Natural Gas Water Heating
■ Heating Oil/Propane Space Conditioning
■ Heating Oil/Propane Water Heating

save at least $10,000 in lifetime costs compared to propane. Where gas infrastructure does not currently exist, households can see significant savings from switching to electric heat pumps.

Given the low carbon intensity in Rhode Island—on average, the marginal emissions intensity is 815 lb./MWh—electrification of space and water heating significantly reduces emissions compared to gas, oil, or propane. Heating oil is particularly carbon intensive, and electrification cuts emissions in half for heating oil customers. Even natural gas systems produce about 50% more carbon emissions than heat pumps.

Given Rhode Island's commitment to reduce statewide

greenhouse gas emissions 85% below 1990 levels by 2050 (and 50% by 2035), electrification of space and water heating will be a critical strategy to meet these targets.

For both new construction and retrofit, heat pumps produce significantly less emissions than all fossil fuels, given the low-carbon electricity mix in New England. Natural gas systems have the second lowest emissions, followed by propane, then heating oil. For both new construction and retrofit, heating-oil systems produce twice the carbon emissions as heat pumps. Natural gas systems produce 40% more carbon emissions than heat pumps in both newly constructed and retrofit buildings.

Recommendations based on Providence results

- Prioritize electrification programs targeting customers currently using heating oil or propane in their homes, as electrification has the greatest immediate carbon and cost benefit for these customers. Specifically, prioritize electrification as a carbon- and cost-reducing measure rather than extension of natural gas service.

- Discontinue utility programs encouraging customers to switch to natural gas,[21] as these programs will not enable Rhode Island to meet its mandate for greenhouse gas reductions. In particular, scrutinize customer-facing language such as the following passage on one utility's website, which gives customers the false impression that natural gas is the cleanest option: "Natural gas is the cleanest-burning fossil fuel and a highly efficient form of energy. It has fewer impurities and reduces CO_2 emissions by 27%, so you'll feel good about helping the environment."[22]

RESULTS: CHICAGO, IL

For newly constructed homes, heat pumps are significantly more cost-effective than installing both air conditioning and a gas furnace and water heater; a heat pump system will save $4,000 over the lifetime of the device.

In existing buildings, heat pump retrofits are more expensive than replacing natural gas furnaces and

water heaters with new gas devices. However, compared to replacing both natural gas systems and air conditioners simultaneously, heat pumps are lower cost.
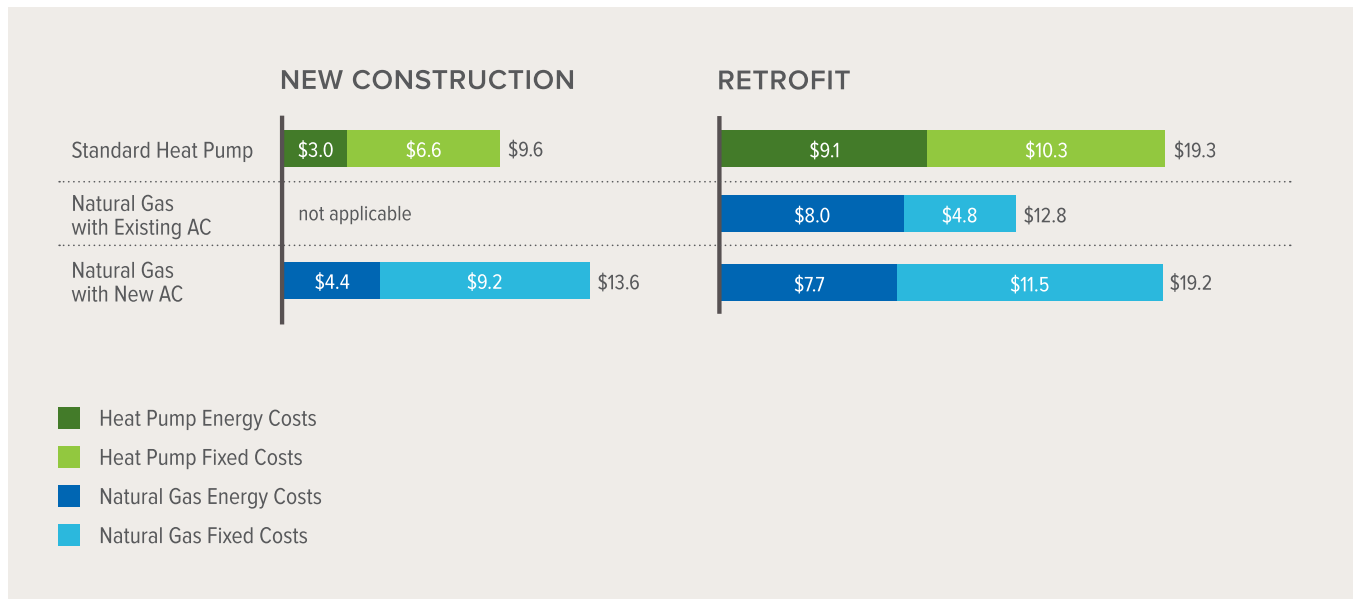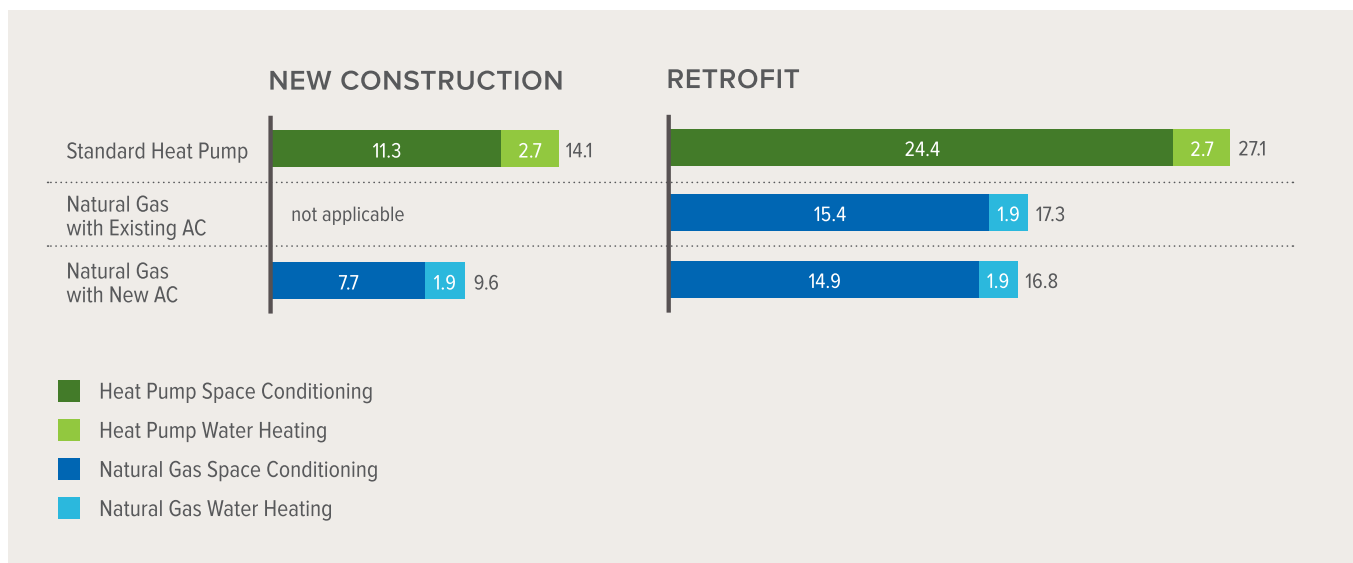
In the Chicago region of the PJM market, marginal generation on the grid is currently dominated by coal, meaning increases in load drive higher coal output today and thus additional short-term emissions. By this short-term marginal measure, heat pump systems have about 50% more carbon emissions than natural gas for both retrofit and new construction homes. This analysis used 2016 marginal emissions data. Since 2016, coal plant retirements and further development of renewable energy projects have continued to change the carbon intensity of the regional grid. For example, the 1,200 MW Pleasant Prairie coal plant just north of Chicago is slated for closure in 2018, as 350 MW of new solar generation is planned in the same region.[23]

Recommendations based on Chicago results

- Continue to prioritize energy efficiency programs while laying the groundwork for customer electrification initiatives in anticipation of continued decarbonization of the regional grid. Given the expectation that substantial market development in building electrification will take several years, during which the continued pace of coal retirement will reduce grid emissions, utilities in the Chicago region should begin developing and introducing these programs now.

FIGURE 20

NET PRESENT COST OF WATER AND SPACE CONDITIONING, CHICAGO (THOUSAND $)

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump	$3.0 / $6.6 / $9.6	$9.1 / $10.3 / $19.3
Natural Gas with Existing AC	not applicable	$8.0 / $4.8 / $12.8
Natural Gas with New AC	$4.4 / $9.2 / $13.6	$7.7 / $11.5 / $19.2

■ Heat Pump Energy Costs
■ Heat Pump Fixed Costs
■ Natural Gas Energy Costs
■ Natural Gas Fixed Costs

FIGURE 21

ANNUAL MARGINAL CARBON EMISSIONS IN CHICAGO (THOUSAND LB. CO_2)

	NEW CONSTRUCTION	RETROFIT
Standard Heat Pump	11.3 / 2.7 / 14.1	24.4 / 2.7 / 27.1
Natural Gas with Existing AC	not applicable	15.4 / 1.9 / 17.3
Natural Gas with New AC	7.7 / 1.9 / 9.6	14.9 / 1.9 / 16.8

■ Heat Pump Space Conditioning
■ Heat Pump Water Heating
■ Natural Gas Space Conditioning
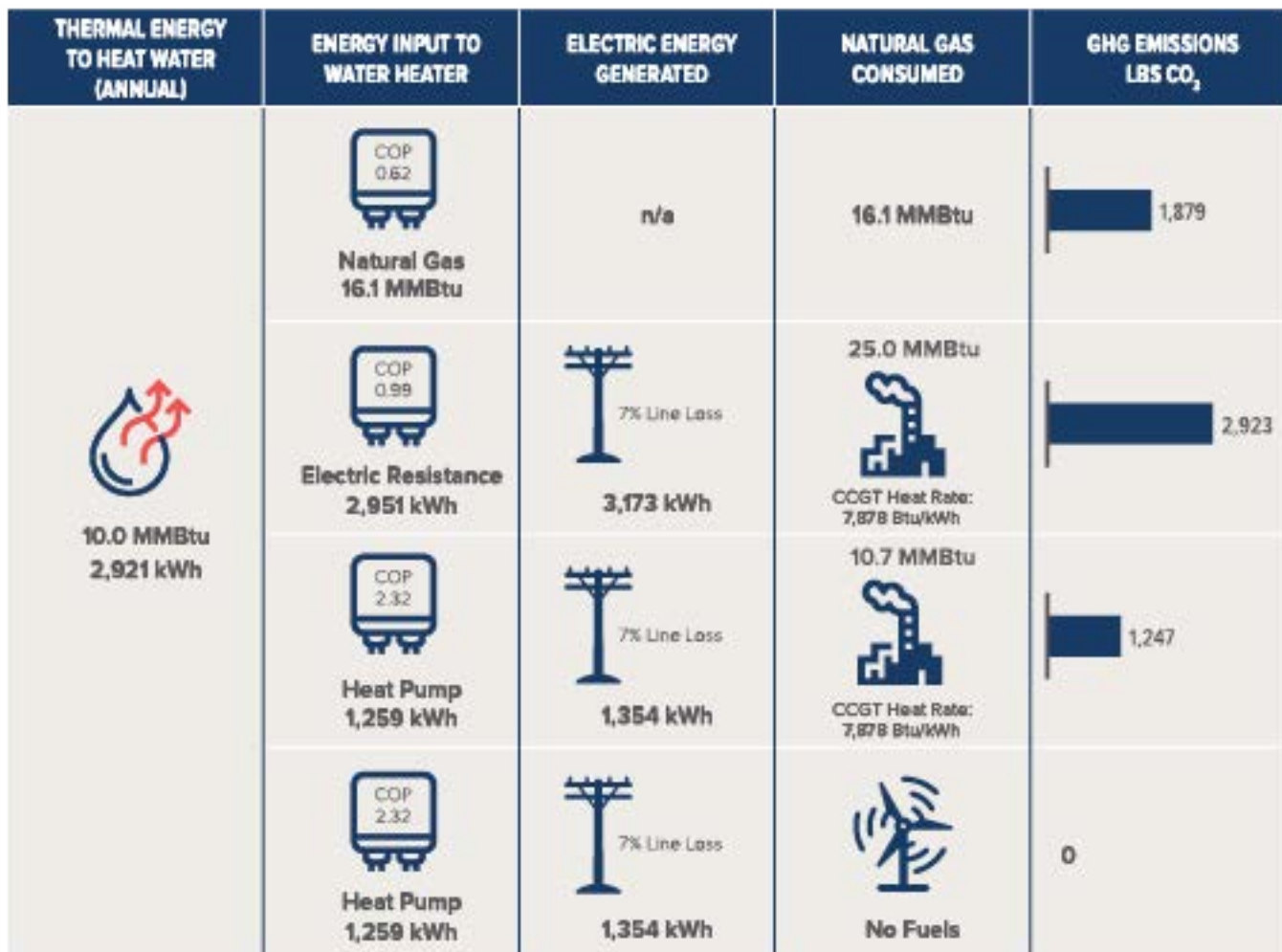■ Natural Gas Water Heating

EVEN WHEN HEAT PUMPS DRAW POWER FROM NATURAL GAS POWER PLANTS, THEY REDUCE CARBON COMPARED TO BURNING GAS IN THE HOME

Across much of the US today, the marginal generator ramping up or down to meet new demand is often powered by natural gas, begging the question whether a natural gas plant powering an electric heat pump is actually more efficient than burning natural gas in the home for heat. Here we compare the annual greenhouse gas emissions of a natural gas-fired water heater with a heat pump water heater that sources its electricity from natural gas. Assuming a combined-cycle gas turbine, the greenhouse gas (GHG) emissions of the electric system are less than the gas-fired water heater. Electric resistance water heaters, which have historically dominated the electric water-heater market, have the highest emissions footprint on a gas-dominated grid. With today's technology, it is less efficient to burn gas in the home than to burn it at

FIGURE 22
COMPARISON OF FUEL CONSUMPTION AND GHG EMISSIONS FOR EXAMPLE WATER HEATING

THERMAL ENERGY TO HEAT WATER (ANNUAL)	ENERGY INPUT TO WATER HEATER	ELECTRIC ENERGY GENERATED	NATURAL GAS CONSUMED	GHG EMISSIONS LBS CO$_2$
10.0 MMBtu 2,921 kWh	COP 0.62 Natural Gas 16.1 MMBtu	n/a	16.1 MMBtu	1,879
	COP 0.99 Electric Resistance 2,951 kWh	7% Line Loss 3,173 kWh	25.0 MMBtu CCGT Heat Rate: 7,878 Btu/kWh	2,923
	COP 2.32 Heat Pump 1,259 kWh	7% Line Loss 1,354 kWh	10.7 MMBtu CCGT Heat Rate: 7,878 Btu/kWh	1,247
	COP 2.32 Heat Pump 1,259 kWh	7% Line Loss 1,354 kWh	No Fuels	0

a power plant and run the electricity to the house. An electricity grid with a higher renewables mix or more efficient generation will have even less emissions.

SPACE AND WATER HEATING: ARE THEY CREATED EQUAL?

Throughout this report we evaluate scenarios that electrify both space and water heating, but they have distinct characteristics that could encourage electrification of one over the other. In addition to the fact that space heating is more energy-intensive and costly (five to eight times more expensive in Chicago, for instance), we describe four additional considerations surrounding the two end uses:

- **Water heaters are better at load shifting:** Water heaters can generally provide more load shifting than space heating, without impacting individual comfort. This is especially true when water can be preheated to very high temperatures (e.g., 150–160°F) and provide hot water to the user for many hours without the need for additional energy use. In our Houston Free Nights scenario, for instance, this strategy shifts the large majority of energy use to nighttime and reduces annual energy costs for water heating from $154 to $48. The same strategy for space heating provides only a few dollars per year of savings, as the building cannot be comfortably heated so high or cooled so low outside normal temperatures, and does not retain heat as well as a water tank.

- **Space heating is more sensitive to climate:** Space heating with air-source heat pumps is

affected more by climate than water heating. While modern cold climate air-source heat pumps perform well at cold temperatures, they are less efficient and consume more energy in these environments. For instance, while the Mitsubishi device we model in Chicago and Providence is capable of providing substantial heat at outdoor temperatures as low as -13°F, the coefficient of performance at max capacity decreases from 3.5 (at 47°F) to 2.1 (at 17°F) to 1.4 (at -13°F). Geothermal heat pumps can perform better at these cold conditions, but are cost-prohibitive for many customers.

- **Electric space heating is less suitable in inefficient buildings:** Space heating is closely tied to the energy efficiency of the building. Our new construction scenarios use 55–67% less energy for heating existing, less efficient homes in the same climates. For relatively inefficient homes, especially in colder climates, bundling insulation and sealing measures will be particularly important to reduce energy from space heating and mitigate the need for costly upgrades to the electric grid to meet increased peak demand.

- **Combining space and water heating in a retrofit unlocks more savings than either alone:** Additional savings are possible from fully electrifying a home and discontinuing service from a gas utility. Many gas bills include a monthly fixed charge for maintaining service (our Chicago scenario includes a $33 per month fixed charge[24]), which can only be eliminated with full home electrification.

05 DEMAND FLEXIBILITY WITH ELECTRIC HEATING

DEMAND FLEXIBILITY WITH ELECTRIC HEATING

Electric space and water heating loads can be optimized to support efficient operation of the electric grid by shifting loads into periods of low-cost and abundant renewable generation, reducing loads during periods of peak demand, and providing other grid support services at the bulk power and local levels. These demand flexibility services can be grouped into four categories:

- **Load shedding** is the reduction of energy demand during periods of high system cost or physical strain on the grid. For space and water heating, many of today's utility demand response programs rely on direct load control to disconnect devices from the grid during peak times, or to cycle devices on and off to reduce their aggregate demand. Load shedding is also known as curtailment.

- **Load shifting** is a deliberate change in the time that energy is consumed, without reducing the total energy provided. Space and water heating loads may be shifted earlier in time by preheating a building or a water tank in advance of a peak period, so the building mass or water can retain enough heat to meet customer comfort needs without additional energy demand during peak time.

- **Bulk power ancillary services** represent more specialized services that support grid operations. These can include frequency regulation, which is provided by electric resistance water heaters today; fast frequency response, requiring very fast disconnect of loads in response to frequency deviations;[vii] and contingency reserves, which can be provided by turning off resistance or heat pump devices on 10–30 minutes notice in response to an unexpected grid event.

- **Local ancillary services** include voltage management, hosting capacity expansion (e.g., by shifting more load into periods of local solar generation), or peak management specific to a distribution circuit. These local services have been deployed in limited cases so far, both in non-wires alternatives projects and in emergency peak management, but could be expanded with sophisticated distributed energy resources management or granular locational pricing.

In this report, we model strategies that combine load shifting (i.e., preheating or precooling ahead of peak periods) and load shedding (i.e., reducing a set point during peak periods) in response to time-of-use electric rates. This is a conservative approach to valuing demand flexibility, as we do not evaluate more granular or dynamic rate structures or the ability to provide ancillary services. We discuss below several approaches to increase the demand flexibility value of these devices, which with new and expanded compensation mechanisms, could further improve the economic value proposition of electrifying space and water heating.

As an illustration of the load shifting value from controllable water heating loads in supporting variable renewables, Figure 23 shows how a modeled customer's average daily load shape for a heat pump water heater changes when optimized for a time-of-use rate. In this example, the customer subscribes to Hawaiian Electric Company's residential time-of-use rate, with cheapest energy during the midday period when solar power is abundant, and most expensive during the system's evening peak. In regular operation without any demand flexibility, the water-heating load is spread throughout the day, with 29% falling during

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vii "Very fast" here refers to programs that can disconnect loads within as little as 0.2 seconds of a frequency deviation.

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the midday period of abundant solar, and 25% during the expensive evening peak. When optimized for the time-of-use rate, however, the water heater preheats aggressively during the midday period, then reduces its set point in the evening period. As a result, two-thirds of the energy is consumed during midday, and only 6% during the expensive peak period. Although the load-shifting strategy consumes 10% more energy over the course of the year, the customer's energy bill is 20% lower than in the uncontrolled scenario.

Notably, this strategy relies on superheating water to much higher temperatures than typical (in this case, up to 150°F). To ensure consumer safety, this strategy requires installation of a thermostatic mixing valve to ensure water is delivered to the user at safe temperatures. Superheating strategies are already in use for demand response, for instance in the Great River Energy program in Minnesota, with 70,000 controlled water heaters.[26]

FIGURE 23

WATER HEATER LOAD SHIFTING FOR HAWAII TIME-OF-USE RATE
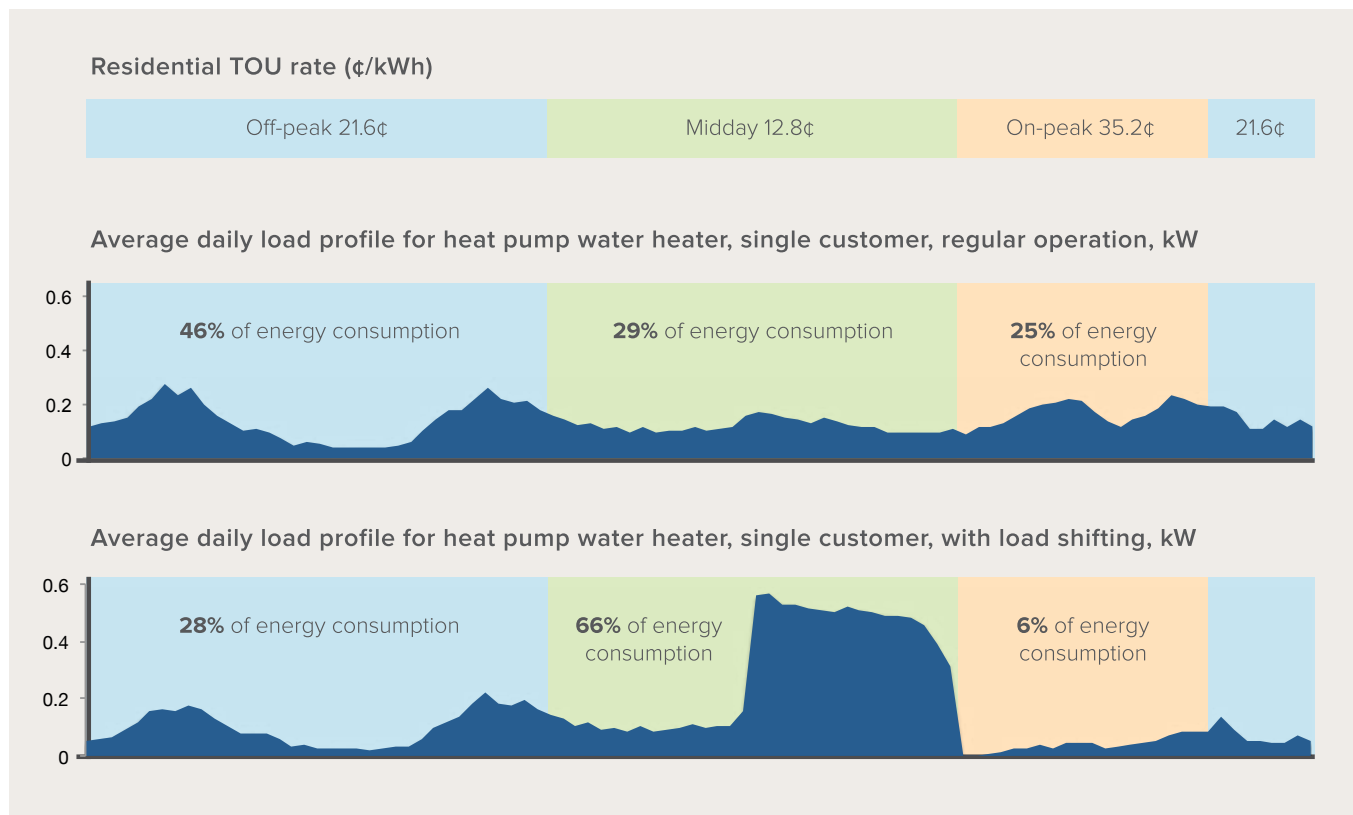
APPROACHES BEYOND TIME-OF-USE OPTIMIZATION

In the scenarios we evaluated we found roughly $2,000 to $4,000 in demand flexibility value, on a 15-year discounted cash flow basis, when optimizing for time-of-use rates with significant peak to off-peak price differentials (i.e., Oakland 3:1 TOU and Houston Free Nights). While these cases certainly offered greater value than those with milder price differentials, they do not fully capture the value demand flexibility could provide with electrified space and water heating. More value could be captured either through improved rate design or expanded demand response programs.

IMPROVED RATE DESIGN

Additional rate elements could enable more value from flexible space and water heating, including critical peak pricing, more granular time periods, and more dynamic pricing:

- **Critical peak pricing** provides very high electricity prices during a limited number of annual events of several hours' duration. In return, the customer's electricity rates are reduced by a few percent all other hours of the year or season. With pre-conditioning and curtailment strategies, electric water heating and space heating and cooling can minimize demand during critical peak periods and reap the benefits of reduced year-round pricing.

- **More granular time periods** can allow more frequent use of pre-conditioning strategies and further reduce the effective price of electricity for heating and cooling. As shown in Figure 24 below, our Oakland 3:1 TOU scenario preheats water once per weekday, before the peak period begins at 4 p.m. However, the California electric system commonly experiences two peak demand periods per day, a morning peak and evening peak, as well as a midday slump in net demand as solar generation meets a significant portion of system

needs. A customer facing multiple peak-off-peak cycles per day could take advantage of more opportunities to preheat during low-cost off-peak periods, and more peak pricing periods could result in lower off-peak pricing. Some rates vary in price hourly or, in extreme cases, minute by minute.

- **More dynamic pricing** offers the customer prices that closely reflect the changing needs of the electric system. Real-time pricing and other dynamic pricing schemes can introduce greater volatility and allow sophisticated device controls to maximize use of energy during low-priced periods. For instance, RMI's most recent demand flexibility report showed how water heaters could evaluate market conditions over the coming 12 hours and dynamically replan its heating schedule to take advantage of low-cost periods.[27] For maximum benefit, these rates should assign time-varying value to distribution and transmission costs as well as energy, or they risk diluting the variation in the price signal.

FIGURE 24

CREATING MORE GRANULAR TIME PERIODS WOULD ALLOW MORE FREQUENT APPLICATION OF
LOAD-SHIFT STRATEGIES
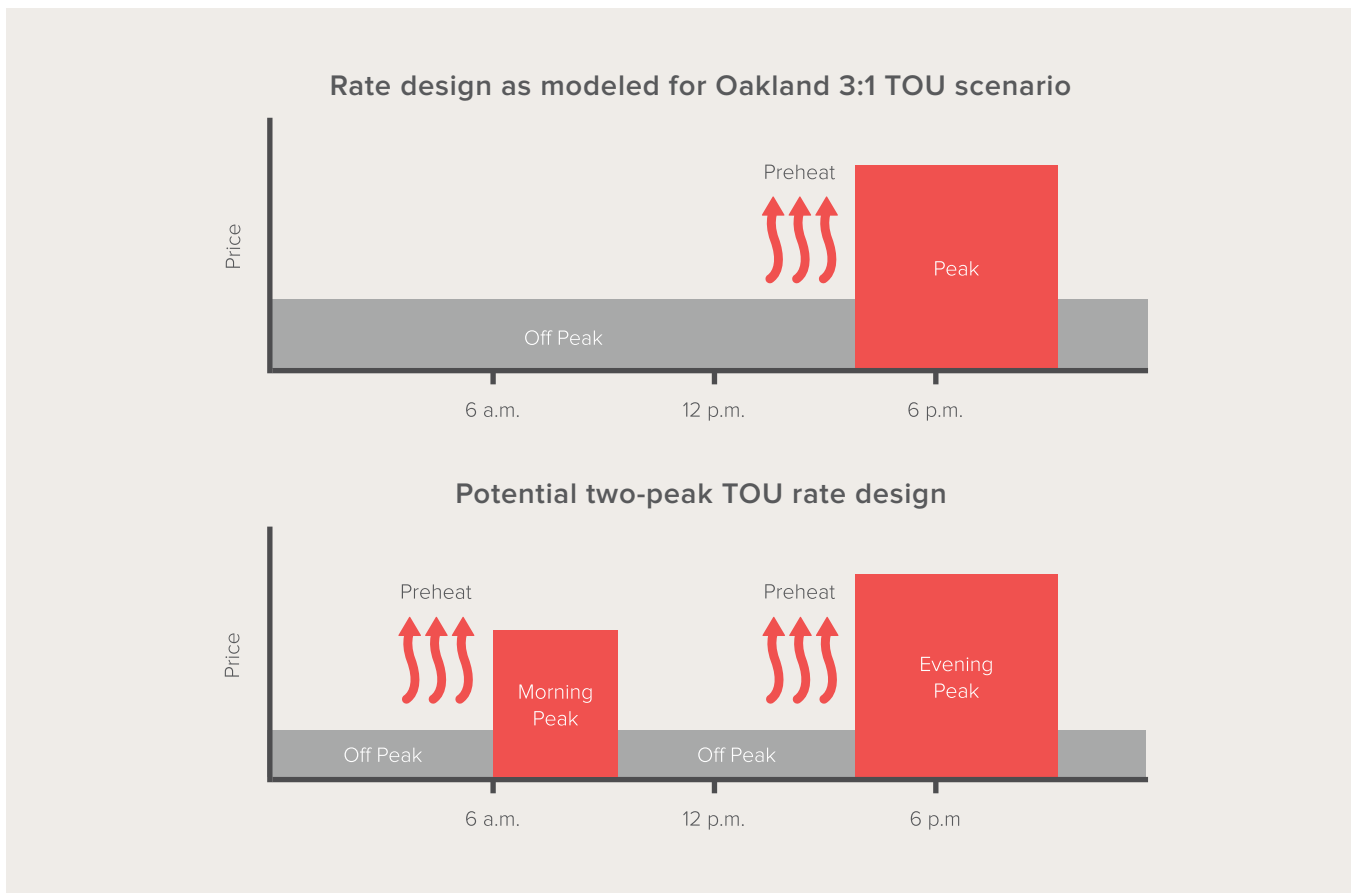
In the near term, these rate design principles may show up in more utility-designed rates. Ultimately, the same principles may manifest in sophisticated transactive energy market structures that offer dynamic, granular, and location-specific pricing reflecting grid needs, customer preferences, and market conditions. The Retail Automated Transactive Energy System (RATES) pilot project in southern California is an early example of such a system, with automated controls optimizing a customer's energy use as spot prices for electricity change dynamically.[28]

DEMAND RESPONSE PROGRAMS

These programs provide centralized control of distributed devices, and may be run by a utility or a third-party aggregator. Their advantage over time-of-use rates is the ability for the aggregator to optimize across multiple value streams based on dynamic grid needs on a highly granular basis in both time and location, without overburdening the customer with complex pricing. Notably, these are starting to expand in scope from traditional utility air conditioning and water-heating demand response programs, which

England peak events, water heaters are curtailed to minimize generation capacity costs. During monthly peaks within Green Mountain Power's service territory, devices are again curtailed to minimize transmission capacity charges. On other days, energy is shifted from high-price periods to low-price periods to reduce variable energy costs. Finally, the utility can bid these aggregated demand resources into the ISO market for products such as frequency regulation or contingency reserves for additional value.

- **Location-specific services:** Demand flexibility can support deferral of location-specific infrastructure upgrades, or provide other services such as increasing hosting capacity for distributed solar by building midday load on saturated circuits.

- **Ancillary services:** Electric space and water heating can also provide valuable ancillary services, either by participating in wholesale markets or by providing them directly to meet utility needs. Traditional electric resistance water heaters already provide frequency regulation to the PJM market through third-party aggregators. In aggregation, heat pump devices could provide this same service, though at smaller scale. They could also offer other products such as contingency reserves. Hawaiian Electric's recently approved demand response programs offer a notable example, with contingency reserves valued at $6 per kW per month, equivalent to up to $80 per year for space and water heating in our residential scenarios.

are often limited to one-way communication to curtail load during peak periods. Enhanced value can also come from value stacking across multiple services, from meeting location-specific grid needs, and from ancillary service provision.

- **Value stacking:** Centrally managed programs can optimize device usage across several value streams. Green Mountain Power's eWater program provides a helpful example. The utility prioritizes among several actions based on greatest system value. During annual ISO New

Across all of these rate design and load control options, we can expect the inherent value of demand flexibility to increase in the future, as power systems increasingly rely on variable renewable energy and net energy demand becomes more variable hour to hour and day to day.

COST-COMPETITIVE SOLAR PLUS ELECTRIFICATION IN CALIFORNIA

Customers who bundle solar with electrification can increase their energy savings and generate solar power to match their additional electricity consumption. We modeled rooftop solar as an addition to our Oakland retrofit default TOU scenario and found that solar plus electrification lowers net present cost below that of either a natural gas retrofit or electrification alone, though it increases initial capital cost.

We found a 6.5 kW solar system optimal for this customer profile, offsetting approximately 90% of the annual whole home electricity demand. This would add more than $15,000 in up-front costs for the solar installation, but reduce energy costs from $2,900 to $170 on an annual basis, or by almost $25,000 over 15 years on a discounted cash flow

basis. Notably, we found that offsetting around 90% of energy consumption was more cost-effective than offsetting 100%, as PG&E's minimum monthly bills negate the benefit of offsetting the last 10% of energy consumption. California's shift to net energy metering by time-of-use period had only a minor effect, as the price differential between peak and off-peak periods is only 19% during summer and 5% the remainder of the year. Although the large up-front cost poses an additional barrier, packaging electrification with a solar installation may allow customers to take advantage of widespread financing mechanisms for rooftop solar, which could readily be expanded to cover electrification costs as well. Solar customers facing potential reductions in credit for exported energy may also find electrification maintains the value of their solar array by enabling more self-consumption of solar power.

FIGURE 25

NET PRESENT COST OF SOLAR PLUS ELECTRIFICATION COMPARED WITH GAS AND ELECTRIC FOR OAKLAND DEFAULT TIME-OF-USE SCENARIO (THOUSAND $)
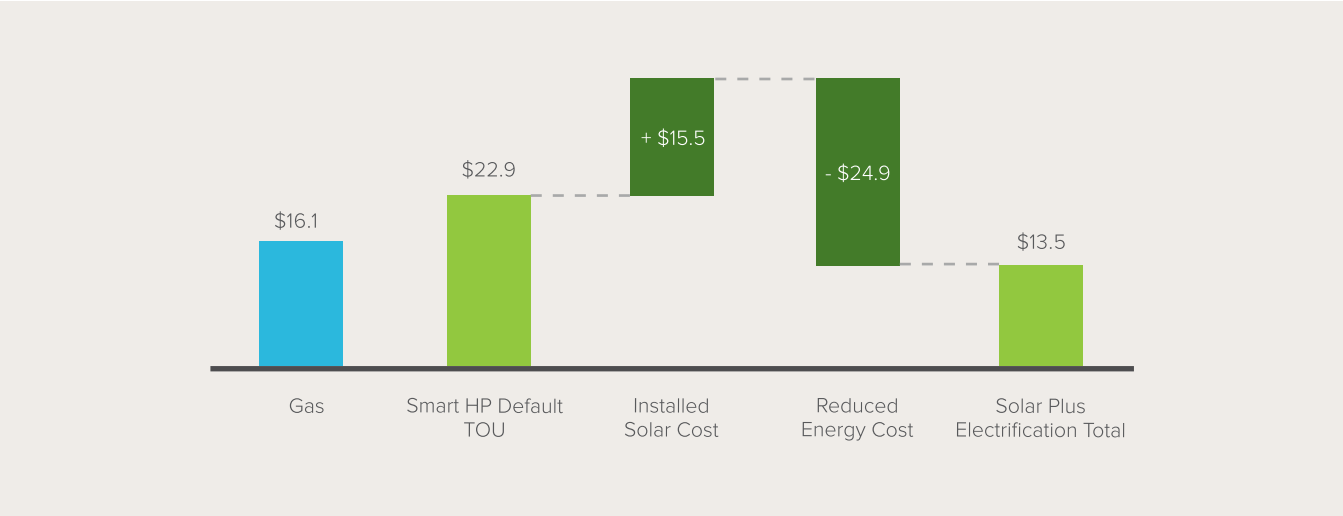
ELECTRIFICATION IS MORE COST-EFFECTIVE THAN EXPANDING GAS INFRASTRUCTURE TO MORE HOMES

Extending gas service to more homes is expensive. These costs can vary widely depending on a building's proximity to existing gas mains and other factors. We compiled utility-provided cost data from regulatory filings or customer quotes in 12 cases across five states, ranging from $1,000 to more than $24,000 per single-family home, with a median value of $8,800.

In Figure 26 we include this cost in comparing two Oakland retrofit scenarios: natural gas and electrification with default TOU for a home that does not already have gas service, showing that the heat pump scenario becomes more cost-effective than natural gas expansion.

Note that a portion of the gas distribution cost is covered by the customer's gas bill payments (45% of gas bills, or $1,400 over 15 years based on PG&E's 2016 revenue requirement[29]), so we only show the incremental cost above this amount: $7,400. In the electrification scenario, there may be additional electric distribution infrastructure costs not shown here.

While customer-specific factors will vary, we expect in most cases that heating electrification will cost less than extending gas service to homes not yet served

FIGURE 26

NET PRESENT COST OF OAKLAND RETROFIT GAS AND ELECTRIFICATION SCENARIOS WITH GAS INFRASTRUCTURE COSTS (THOUSAND $). ERROR BAR SHOWS 25TH AND 75TH PERCENTILE OF ESTIMATED GAS MAIN AND SERVICE COSTS
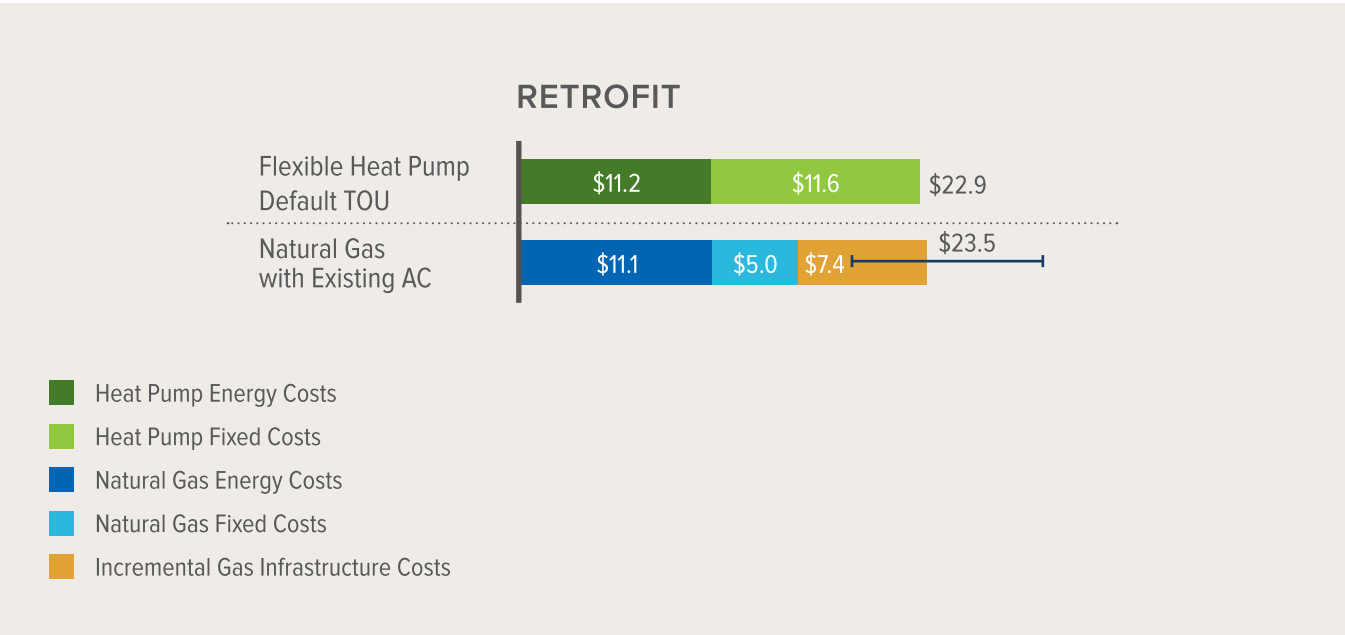
by gas, and that electrification of newly constructed homes will become even more attractive when developers and ratepayers can avoid the cost of gas mains and services.

COST CHANGES NEEDED FOR COST-EFFECTIVE BUILDING ELECTRIFICATION RETROFITS

As shown above, in many retrofit scenarios for a home with existing natural gas space and water heating, switching to electric heat pump devices is more expensive today than retrofitting with a new gas furnace and water heater. A notable exception is the customer needing to replace both his furnace and air conditioner, which can be replaced with a single heat pump that performs both functions. But for the majority of homes currently using gas, changes to today's costs will be needed to make widespread electrification the low-cost option. Just as the solar industry has made progress reducing soft costs in solar energy installations, cost reductions in electrification will need to extend beyond appliance costs to include permitting, installation, financing, and customer acquisition. Several such changes could emerge, depending on the scale of market growth for heat pumps and many other unpredictable factors:

- **Device and installation costs are likely to decline:** Heat pump water heaters make up less than 1% of water heater sales today,[30] and their unsubsidized purchase prices are two or more times those of natural gas water heaters. Given the current immaturity of the market for these products, and the potential for significant economies of scale with increasing market share, their costs are likely to decline in the future. The National Renewable Energy Laboratory's (NREL's) *Electrification Futures Study* projects cost declines of 20–38% for air-source heat pumps and 42–48% for heat pump water heaters by 2050.[31] Likewise, in

regions where contractors are currently unfamiliar with heat pump products, increasing scale and familiarity may reduce installation costs in the future.

- **The value of demand flexibility is likely to increase:** As variable renewable energy continues to grow, electricity markets will be more likely to experience large price differentials across seasons and times of day, including more periods of near-zero or negative wholesale pricing. This will inherently increase the value of flexible demand, and increase the value available to customers with flexible electric space and water heating.

- **Carbon pricing may expand and rise:** California is currently the only state where carbon pricing is applied to distributed natural gas, at a value

around $15/ton.[32] At this value, a California gas customer is paying $14 extra per year in energy bills compared to an electric heat pump customer. As the statewide emissions cap declines in the future, and as the decarbonization of California's electric grid increases the carbon advantage of heat pumps over natural gas, these factors together will improve the cost-effectiveness of electrification. Other states may launch new carbon-pricing schemes that include distributed fuels, shifting the cost equation in other parts of the country.

- **Natural gas prices may rise:** Residential gas commodity prices are unpredictable and have remained relatively stable since 2010,[33] so we make no prediction of rising gas prices, but higher prices would improve the cost-effectiveness of electrification.

RECOMMENDATIONS FOR UTILITIES, REGULATORS, AND POLICYMAKERS

Electrification of space and water heating presents a viable pathway to deep decarbonization, reduces carbon emissions in all but the most coal-dominated regions, can support renewable energy integration with the proper control strategies, and costs less than fossil fuel alternatives in a significant portion of scenarios. However, most of the 56 million American households currently heated with natural gas will not find it cost-effective to switch to electric heat pumps at today's prices. To capture the near-term benefits of fuel switching in the most advantageous scenarios, and to prepare for a long-term approach that includes widespread cost-effective electrification, we offer five immediate recommendations for regulators, policymakers, and utilities:

1. Prioritize rapid electrification of buildings currently using propane and heating oil in space and water heating

2. Stop supporting the expansion of the natural gas distribution system, including for new construction

3. Bundle demand flexibility and energy efficiency programs with electrification initiatives

4. Expand demand flexibility options for existing electric space and water heating loads

5. Update energy efficiency resource standards and related goals to account for total energy reduction across fuels

RECOMMENDATION 1: PRIORITIZE RAPID ELECTRIFICATION OF BUILDINGS CURRENTLY USING PROPANE AND HEATING OIL IN SPACE AND WATER HEATING

RATIONALE
Electrification of homes using propane and heating oil for space and water heating already reduces carbon emissions and costs less (than propane) or the same (as oil). These fuels are more carbon-intensive and more expensive than either natural gas or electric
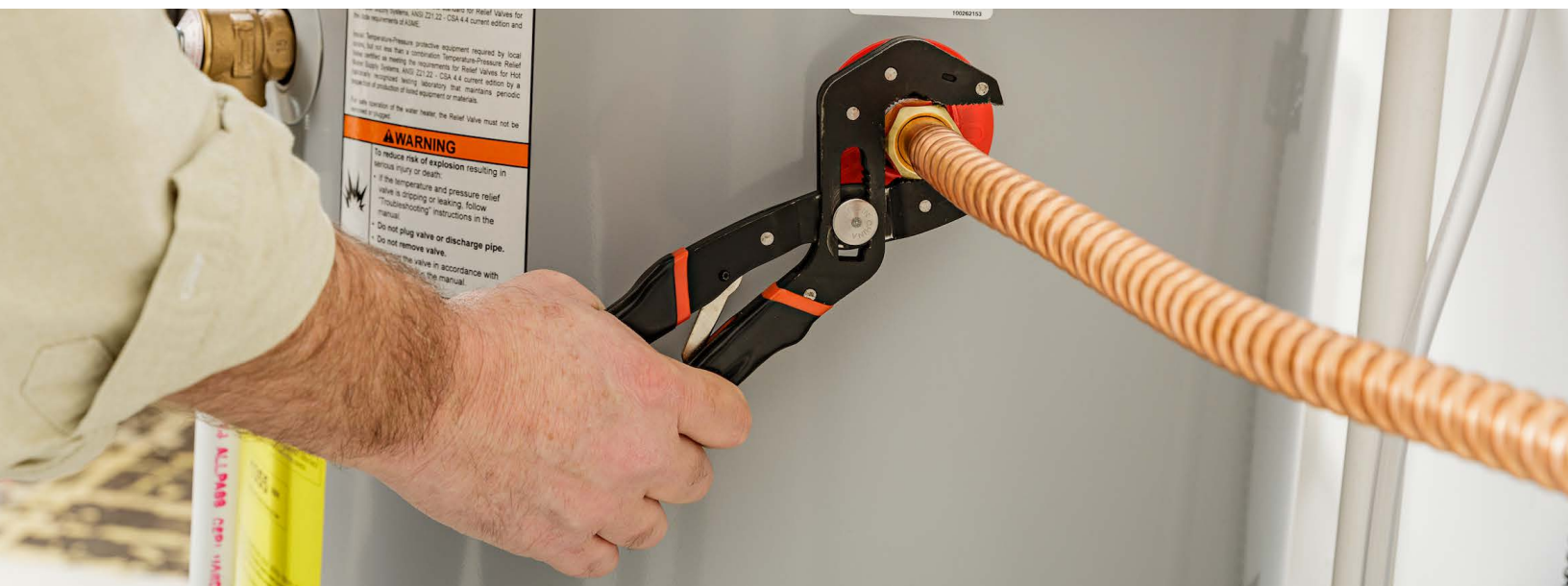
heat pumps. These homes typically do not have existing natural gas service, and switching customers to electricity is more cost-effective than extending gas mains and services to more customers. And although less than 10% of homes heat with propane or heating oil,[34] these fuels account for more than 20% of residential fossil fuel carbon emissions.[35]

RECOMMENDED ACTIONS:

- Prioritize energy efficiency incentives and targeted utility programs that displace consumption of propane and heating oil with efficient electric heat pumps.

- Make electrification easier for customers by promoting it through utility marketing, developing a qualified contractor network for simple installation experience, providing standard financing offers, and structuring rebates so customers receive them at point of sale.

- Promote policy actions such as the Tier III Energy Transformation requirement in Vermont's Renewable Energy Standard,[36] which requires utilities to implement carbon-reducing projects such as electrification for customers, or Massachusetts' integration of heat pumps and other "renewable thermal" technologies into its Alternative Portfolio Standard.[37]

RECOMMENDATION 2: STOP SUPPORTING THE EXPANSION OF THE NATURAL GAS DISTRIBUTION SYSTEM, INCLUDING FOR NEW CONSTRUCTION

RATIONALE

Continued expansion of the natural gas distribution system is incompatible with the imperative to decarbonize buildings' energy use. Fourteen states currently have official targets of greater than 75%

reductions in greenhouse gas emissions by mid-century,[38] and achieving these goals will require discontinuing the large majority of natural gas use in buildings. This means that many or all gas mains and services built today will cease to be used and useful by 2050 at the latest and will become stranded assets. This stranded asset risk alone should give regulators pause in their approval of continued ratepayer-funded investment in gas system expansion.

Many utilities—including the two largest in New England—prominently advertise to customers the option to switch to natural gas as a clean and cost-effective option without stating that electrification can be cleaner and more cost-effective.[39] State energy strategies may promote gas expansion, even while acknowledging the long-term need for building electrification. Connecticut's 2018 Comprehensive Energy Strategy does just this, simultaneously touting as an example of progress that the state "converted 39,104 residential customers to natural gas for heating" and stating that "to achieve the vision of a zero-carbon economy, widespread electrification of building thermal loads and the transportation sector is required."[40]

As shown in this report, electrification of homes, whether new construction or existing but not currently served by gas, is more cost-effective than extending gas service to these homes, installing gas furnaces and water heaters, and consuming gas to fuel them over their lifetimes, and already reduces carbon emissions in all but the most coal-intensive grids.

An ongoing California proceeding offers an immediate example. The state is considering funding gas service extension to disadvantaged communities in the San Joaquin Valley currently served by propane at high cost.[41] Pilot projects under this proceeding will compare the costs of whole home electrification to costs of gas service extension, including appliance upgrades. Initial utility cost estimates for gas

expansion significantly exceed the typical utility allowance for such projects of around $2,000 per household.[42] Given California's commitment to 80% reduction in greenhouse gas emissions by 2050, consideration of public funding for gas expansion should acknowledge that achieving the state's climate goals would require foregoing use of this gas infrastructure by 2050 in favor of all-electric solutions.

RECOMMENDED ACTIONS:

- Public utilities commissions can reexamine the methodology by which they determine utilities' allowance for costs of gas expansion. Typically, utility ratepayers fund the cost of gas system expansion up to a predetermined allowance, above which the developer (of new homes) or customer (of existing homes) must pay additional construction costs. These allowances are calculated as the net present value of distribution costs paid through customer rates over long time periods (e.g., 60 years in California,[43] 40 years in Pennsylvania[44]). Regulators should reconsider whether such long time horizons are appropriate given the risk of stranded assets.

- State energy offices can cease support for continued gas system expansion in their energy strategies and instead prioritize measures for building electrification.

- Cities can phase in all-electric, net-zero energy requirements for new construction, as described in RMI's *The Carbon-Free City Handbook*.[45]

- Regulators and policymakers considering new ratepayer-funded gas expansion to underserved communities should evaluate all-electric solutions carefully in comparison with gas options, acknowledging that new gas infrastructure bears significant stranded asset risk associated with the need to meet climate goals.

RECOMMENDATION 3: BUNDLE DEMAND FLEXIBILITY PROGRAMS, NEW RATE DESIGNS, AND ENERGY EFFICIENCY WITH ELECTRIFICATION INITIATIVES

RATIONALE

Widespread electrification will add substantial new load to the electricity system, and if not well managed could eventually impose large costs on the electricity system at both the bulk and local levels. Demand flexibility can shift load from high-cost to low-cost times, minimize contribution to system peak (especially in winter), and help cost-effectively integrate high penetrations of variable renewable energy. The value of this demand flexibility to the system will increase in the future, as growing renewable generation introduces more extended periods of zero or negative marginal pricing in electricity markets, while increasing the need for fast-ramping resources to balance the system. Energy efficiency can substantially reduce the total energy use and peak demand, especially for space heating. The efficient new construction buildings modeled in our analysis consume roughly half the energy for space heating as the existing buildings in the same cities.

RECOMMENDED ACTIONS:

- Utilities can bundle electrification initiatives with new demand flexibility customer programs. Green Mountain Power's eControl offer provides a notable example, as a free connected add-on to ductless heat pumps that offers the utility the ability to shift or curtail demand when needed.[46] This product can be offered in concert with GMP's utility-run ductless heat pump program.

- Likewise, utilities or contractors providing electrification retrofits to customers should evaluate home energy performance and offer efficiency upgrades at the same time, to reduce

the size and cost of heat pump needed and to reduce energy demand and cost.

- Expand utility rebate programs for air conditioning to offer incentives for customers replacing traditional air conditioning units with efficient heat pump units for both cooling and heating.

- Expand time-varying rates to more customers, and ensure they offer a meaningful price differential that will actually result in load shifting. Note that programs like the California utilities' proposed default time-of-use rates offer price differentials that are too small to offer meaningful value from load shifting thermal loads, as shown in the body of this report.

- Default all or a portion of customers onto these time-varying rates. This could mean all customers, all participants in an electrification program, all new customers, or some other subset. Using time-varying rates as a default option will ensure they reach many more customers than opt-in approaches.

RECOMMENDATION 4: EXPAND DEMAND FLEXIBILITY OPTIONS FOR EXISTING ELECTRIC SPACE AND WATER HEATING LOADS

RATIONALE

There are more than 50 million electric water heaters currently installed in the US,[47] and only 1% of those participate in demand response programs.[48] Likewise, the more than three million customers enrolled in either air conditioner switch or thermostat demand response programs (mostly for air conditioning rather than heating)[49] is small in comparison to the 43 million homes using electric space heating.[50]

These devices, especially the higher-powered

resistance devices, can offer the same peak management and renewables integration benefits described above for heat pumps, at even higher value per device (because they consume more energy in the first place). Additionally, electric resistance water heaters are particularly adept at providing sophisticated grid services like frequency regulation, as in PJM where aggregated water heaters provided an average of more than 100 MW of regulation in 2017.[51]

RECOMMENDED ACTIONS:

- Remove barriers to aggregated demand-side resource participation in wholesale market products, including energy, capacity, and ancillary services. These barriers include prohibitions on aggregated demand-side resource participation in some products and large minimum resource size requirements for individual loads or aggregations. The Federal Energy Regulatory Commission (FERC) is currently considering action to remove such barriers by requiring markets it regulates to allow aggregated resources to participate alongside traditional resources.[52]

- Expand utility demand response programs to cover more end uses and provide more services with each load. Many utilities lack water-heater demand response offerings, or smart thermostat programs that can address both heating and cooling. Utilities can also take a "value stacking" approach to dispatching enrolled resources for maximum value, optimizing value across generation, transmission, and distribution capacity; energy arbitrage; and ancillary services.

- Expand time-varying rates to more customers through default time-of-use rates or other rate designs that include significant price differentiation across time.

RECOMMENDATION 5: UPDATE ENERGY EFFICIENCY RESOURCE STANDARDS AND RELATED GOALS TO ACCOUNT FOR TOTAL ENERGY REDUCTION ACROSS FUELS

RATIONALE

Regulators, policymakers, and utilities will need to make adjustments to energy efficiency programs and targets in order to accommodate beneficial electrification. Energy efficiency programs have traditionally focused separately on reducing electric energy consumption (in kWh) and natural gas energy consumption (in therms).[53] This approach risks providing a disincentive to beneficial fuel switching, either for buildings or transportation, if a utility will be penalized for adding kWh of electric consumption to the system. Rather, energy efficiency targets should either be measured on a total energy basis—combining electricity, natural gas, and other fuels—or on the basis of total emissions associated with the energy consumption, as articulated in the 2016 *Electricity Journal* article "Environmentally Beneficial Electrification: The Dawn of 'Emissions Efficiency.'"[54] Otherwise, successful electrification could penalize utilities for not reducing electricity demand, even when it provides cost and carbon benefits. Additionally, policies that prohibit utilities from promoting fuel switching should be reevaluated to consider the benefits electrification could provide in meeting policy goals, including carbon reduction.

RECOMMENDED ACTIONS:

- Update energy efficiency resource standards to allow utilities to meet their obligations with beneficial electrification that reduces total energy consumption or total emissions.

- Amend restrictions that prevent utilities from promoting beneficial electrification, particularly when it supports state policy objectives.

CONCLUSION

Ultimately, reaching decarbonization goals will require displacing a significant amount of the existing natural gas use that heats space and water in buildings. Our analysis shows that replacing natural gas furnaces and water heaters with electric heat pump devices is often not cost-effective at today's costs. While some proposed concepts offer notable exceptions—such as "non-pipes alternatives" projects that redirect funds from planned gas main and service replacement to instead electrify the buildings served by the relevant gas main—widespread electrification will require some combination of additional cost reductions or increased value proposition to customers. These may include:

- Reduction in price of heat pumps, which is expected through greater economies of scale as the market for these products grows. NREL estimates these price declines will range from 20–38% for air-source heat pumps and 42–48% for heat pump water heaters by 2050[55]

- Reduction in contractor price for heat pump installation, which could occur as contractors become more familiar with newer heat pump devices, or as utilities or other entities develop bulk purchasing agreements with contractor networks

- Increasing future value of demand flexibility, as high penetrations of variable renewables create wider daily spreads in energy prices, and markets and pricing evolve to empower customers to capture more of this value

- Increasing applicability of carbon pricing (and higher carbon prices) applied to distributed fuels like natural gas (currently only existing in California)

- Increases in natural gas prices

These long-term developments, supported by near-term actions such as rapid electrification of propane and heating oil uses, cessation of the natural gas distribution system's expansion, and widespread participation of electric thermal loads in demand flexibility programs or time-varying pricing, can all advance a future in which buildings are completely powered by carbon-free energy and actively help balance a highly renewable, efficient, and affordable electric power system.

APPENDIX: METHODOLOGY

SCENARIOS

GEOGRAPHY	SPACE AND WATER HEATING FUEL	RETROFIT SCENARIOS	NEW CONSTRUCTION SCENARIOS
CHICAGO, IL	**Electricity**	Standard heat pump on a flat rate	Standard heat pump on a flat rate
	Natural gas	Gas with new air conditioner Gas with existing air conditioner	Gas with new air conditioner
HOUSTON, TX	**Electricity**	Standard heat pump on a flat rate Standard heat pump on "Free Nights" Flexible heat pump on "Free Nights"	Standard heat pump on a flat rate Standard heat pump on "Free Nights" Flexible heat pump on "Free Nights"
	Natural gas	Gas with new air conditioner Gas with existing air conditioner	Gas with new air conditioner
OAKLAND, CA	**Electricity**	Standard heat pump on default TOU rate Flexible heat pump on default TOU rate Flexible heat pump on 3:1 TOU rate	Standard heat pump on default TOU rate Flexible heat pump on default TOU rate Flexible heat pump on 3:1 TOU rate
	Natural gas	Gas with new air conditioner Gas with existing air conditioner	Gas with new air conditioner
PROVIDENCE, RI	**Electricity**	Standard heat pump on a flat rate	Standard heat pump on a flat rate
	Natural gas	Gas with new air conditioner Gas with existing air conditioner	Gas with new air conditioner
	Propane	Propane with new air conditioner Propane with existing air conditioner	Propane with new air conditioner
	Heating oil	Oil with new air conditioner Oil with existing air conditioner	Oil with new air conditioner

We model air-source heat pumps as the electrification option. "Standard devices" are air-source heat pumps for space conditioning and water heating, which do not shift load to capture value from time-varying rates. "Flexible devices" are able to take advantage of time-varying rates by preheating or precooling in times of low-cost electricity, in order to use less energy during high-cost times. We compare these heat pump systems to natural gas systems in all geographies. We also evaluate heating oil and propane in Rhode Island, as these fuels are still common in New England.

All scenarios assume the purchase and installation of new equipment. In electric scenarios, households are installing heat pump water heaters and air-source heat pumps for space conditioning. In fossil fuel scenarios, households are installing fossil-fuel-fired water heaters and furnaces. We analyze the cost and emissions of replacing only the fossil fuel water and space heating, as well as simultaneously replacing an air conditioning unit.

We model load and consumption for both water heating and space conditioning on 15-minute increments for a full year, using 2016 weather data.

WATER HEATING

The load profile for water heating is the same as used in RMI's *The Economics of Demand Flexibility Report*, sourced from The Northwest Energy Efficiency Alliance's "Residential Building Stock Assessment."[56] This reflects one customer load profile; other customers (e.g., larger families with more load) would have a different load profile, or might need a water

heater larger than the 45 gallons we model. We use a variable coefficient of performance (COP) curve provided by Ecotope, based on lab testing of heat pump water heaters at different water temperatures. Our preheating strategies heat water to temperatures as high as 150°F and assume these devices are equipped with thermostatic mixing valves to ensure delivery of water to the customer at safe temperatures. Heat pump water heaters have resistance heating elements, which we model as turning on only to keep the average tank temperature above a minimum threshold temperature of 113°F.

SPACE CONDITIONING

Each scenario has a retrofit and a new construction instance, to account for increased efficiency of newly constructed homes. All scenarios assume some common elements: a 2,401-square-foot single-family home with centrally ducted heating and air conditioning. The retrofit scenarios model a poorly insulated home, while new constructed homes model a well-insulated and efficient home. Further building details are below. We use EnergyPlus to determine the heating and cooling load in 15-minute increments for each home and geography. We use performance characteristics for cold climate heat pumps from the Northeast Energy Efficiency Partnerships' cold climate air-source heat pump list.[57] To optimize for time-varying electric rates, we apply preheat and precool strategies. We assume existing air conditioners to be have a seasonal energy efficiency rating (SEER) of 14, slightly less efficient than new air conditioning systems with a SEER of 16. The heat pumps modeled have SEER 18 air conditioning performance.

GEOGRAPHY	HOME TYPE	SEER	SEER	TONNAGE
CHICAGO, IL	Retrofit	Heat pump	18	5
		Existing AC	14	N/A
		New AC	16	5
	New construction	Heat pump	18	2
		New AC	16	2
HOUSTON, TX	Retrofit	Heat pump	18	5
		Existing AC	14	N/A
		New AC	16	5
	New construction	Heat pump	18	3
		New AC	16	3
OAKLAND, CA	Retrofit	Heat pump	18	34
		Existing AC	14	N/A
		New AC	16	4
	New construction	Heat pump	18	2
		New AC	16	2
PROVIDENCE, RI	Retrofit	Heat pump	17.8	5
		Existing AC	14	N/A
		New AC	16	5
	New construction	Heat pump	17.8	2
		New AC	16	2

TECHNOLOGY	WATER HEATING COP	SPACE HEATING COP
Air-source heat pump	2.53–2.64	Varies
Natural gas	0.62	0.95
Heating oil	0.59	0.85
Propane	0.62	0.95

HOME TYPE	GEOGRAPHY	WALL U	ROOF U	WINDOW U	ACH (INFILTRATION)
NEW CONSTRUCTION	Oakland	0.061	0.543	0.350	0.224
	Chicago	0.061	0.543	0.320	0.264
	Providence	0.061	0.543	0.320	0.254
	Houston	0.087	0.543	0.400	0.309
RETROFIT	Oakland	0.200	0.543	0.780	0.736
	Chicago	0.087	0.543	0.511	0.875
	Providence	0.087	0.543	0.511	0.841
	Houston	0.259	0.543	0.78	0.613

ENERGY COSTS

CITY	ENERGY SOURCE	RATE	PRICE
OAKLAND	Electricity	PG&E E-TOU-C[58]	see next table
		3:1 TOU (representative)	see next table
	Gas	Baseline, $/therm	1.2616
		Excess, $/therm	1.7930
CHICAGO	Electricity	ComEd flat bundled,[59] $/kWh	0.1110
	Gas	Customer Charge, $/month	33.4700
		Heating customer,[60] $/therm	0.5617
PROVIDENCE	Electricity	A-16 supply + delivery,[61] $/kWh	0.1889
	Gas[62]	Customer Charge, $/month	13.0000
		Head, $/therm	1.2262
		Tail, $/therm	1.0600
	Propane	EIA average of 2017 price,[63] $/gallon	3.6467
	Heating Oil	EIA average of 2017 price, $/gallon	2.8946
HOUSTON	Electricity	Free Nights,[64] $/kWh 6 a.m.–9 p.m.	0.1959
	Electricity	Flat Rate,[65] $/kWh	0.1069
	Gas	Centerpoint,[66] $/therm	0.6240
		Customer charge,[67] $/month	15.7500

CALIFORNIA TOU RATES

	DEFAULT TOU ($/KWH)	3:1 TOU ($/KWH)
Weekday Summer Off-Peak	0.28037	0.20
Weekday Summer Peak	0.33456	0.60
Weekday Winter Off-Peak	0.26444	0.19
Weekday Winter Peak	0.27870	0.56
Weekend Summer Off-Peak	0.28037	0.20
Weekend Winter Off-Peak	0.26444	0.19

DEVICE COSTS

Device costs are sourced from manufacturer input from Mistubuishi and Homewyse, the online reference for home design and construction. Installation costs are sourced from Homewyse for all retrofit scenarios. We scale installation costs for new construction homes—lower for heat pumps and higher for fossil fuel systems—based on data from BeOpt, NREL's building optimization software.

CITY	BUILDING TYPE	SCENARIO	FIXED COSTS	
			WATER HEATER	SPACE HEATING
OAKLAND	Retrofit	Standard heat pump, default TOU	$2,241	$8,641
		Flexible heat pump, 3:1 TOU	$2,416	$8,816
		Flexible heat pump, default TOU	$2,416	$8,816
		Natural gas, existing AC	$1,426	$3,581
		Natural gas, new AC	$1,426	$11,088
	New Construction	Standard heat pump, default TOU	$1,828	$4,931
		Flexible heat pump, 3:1 TOU	$2,003	$5,106
		Flexible heat pump, default TOU	$2,003	$5,106
		Natural gas, new AC	$1,444	$8,017
CHICAGO	Retrofit	Standard heat pump	$2,186	$7,697
		Natural gas, existing AC	$1,365	$3,450
		Natural gas, new AC	$1,365	$10,140
	New Construction	Standard heat pump	$1,807	$4,840
		Natural gas, new AC	$1,382	$7,791
PROVIDENCE	Retrofit	Standard heat pump	$2,132	$7,522
		Natural gas, existing AC	$1,306	$3,323
		Natural gas, new AC	$1,306	$9,853
		Heating oil, new AC	$2,175	$9,534
		Heating oil, existing AC	$2,175	$3,004
		Propane, new AC	$1,359	$9,853
		Propane, existing AC	$1,359	$3,323
	New Construction	Standard heat pump	$1,786	$4,752
		Natural gas, new AC	$1,322	$7,573
		Heating oil, new AC	$2,190	$6,700
		Propane, new AC	$1,375	$7,573
HOUSTON	Retrofit	Standard heat pump, flat rate	$2,062	$8,027
		Standard heat pump, Free Nights	$2,062	$8,054
		Flexible heat pump, Free Nights	$2,062	$8,049
		Natural gas, existing AC	$1,228	$3,156
		Natural gas, new AC	$1,228	$10,114
	New Construction	Standard heat pump, flat rate	$1,759	$5,770
		Standard heat pump, Free Nights	$1,759	$5,770
		Flexible heat pump, Free Nights	$1,934	$5,862
		Natural gas, new AC	$1,242	$8,345

CITY	BUILDING TYPE	SCENARIO	WATER HEATER				SPACE COOLING			SPACE HEATING			
			ENERGY (KWH)	ANNUAL CARBON (LB.)	ANNUAL FUEL COSTS ($)	NPC ($)	ENERGY (KWH)	ANNUAL FUEL COSTS ($)	ANNUAL CARBON (LB.)	ENERGY (KWH)	ANNUAL FUEL COSTS ($)	ANNUAL CARBON (LB.)	SPACE NPC ($)
OAKLAND	Retrofit	Standard heat pump, default TOU	1,258	1,246	$342	$5,754	1,913	$539	1,959	2,156	$575	2,108	$17,101
		Flexible heat pump, 3:1 TOU	1,315	1,301	$274	$5,314	1,938	$496	1,986	2,011	$423	1,962	$15,501
		Flexible heat pump, default TOU	1,257	1,245	$340	$5,916	1,938	$544	1,986	2,011	$535	1,962	$16,965
		Natural gas, existing AC	4,706	1,879	$251	$3,710	2,412	$678	2,467	8,108	$349	3,238	$12,933
		Natural gas, new AC	4,706	1,879	$251	$3,710	2,219	$624	2,270	8,108	$349	3,238	$19,947
	New Construction	Standard heat pump, default TOU	1,258	1,246	$342	$4,941	575	$167	597	718	$192	702	$6,513
		Flexible heat pump, 3:1 TOU	1,315	1,301	$274	$4,502	610	$182	633	674	$142	660	$6,373
		Flexible heat pump, default TOU	1,257	1,245	$340	$5,103	610	$176	633	674	$180	660	$6,661
		Natural gas, new AC	4,706	1,879	$203	$3,290	713	$206	740	1,410	$61	563	$10,447
CHICAGO	Retrofit	Standard heat pump	1,258	2,727	$140	$3,857	2,477	$275	4,927	8,850	$982	19,439	$15,489
		Natural gas, existing AC	4,706	1,879	$90	$2,187	3,048	$338	6,076	23,421	$449	9,352	$17,310
		Natural gas, new AC	4,706	1,879	$90	$2,187	2,804	$311	5,590	23,421	$449	9,352	$10,373
	New Construction	Standard heat pump	1,258	2,727	$140	$3,078	1,501	$167	2,979	3,800	$422	8,355	$6,540
		Natural gas, new AC	4,706	1,879	$90	$2,204	1,774	$197	3,533	10,497	$201	4,191	$11,417

CITY	BUILDING TYPE	SCENARIO	WATER HEATER				SPACE COOLING			SPACE HEATING			
			ENERGY (KWH)	ANNUAL CARBON (LB.)	ANNUAL FUEL COSTS ($)	NPC ($)	ENERGY (KWH)	ANNUAL FUEL COSTS ($)	ANNUAL CARBON (LB.)	ENERGY (KWH)	ANNUAL FUEL COSTS ($)	ANNUAL CARBON (LB.)	SPACE NPC ($)
PROVIDENCE	Retrofit	Standard heat pump	1,258	1,020	$238	$4,697	2,081	$393	2,026	6,562	$1,240	5,140	$20,886
		Natural gas, existing AC	4,706	1,879	$188	$3,014	2,577	$487	2,496	19,844	$782	7,924	$14,883
		Natural gas, new AC	4,706	1,879	$188	$3,014	2,371	$448	2,296	19,844	$782	7,924	$21,059
		Heating oil, new AC	4,946	2,723	$353	$5,387	2,371	$448	2,296	22,179	$1,582	12,206	$28,019
		Heating oil, existing AC	4,946	2,723	$353	$5,387	2,577	$487	2,496	22,179	$1,582	12,206	$21,844
		Propane, new AC	4,706	2,232	$641	$7,199	2,371	$448	2,296	19,844	$2,703	9,411	$38,555
		Propane, existing AC	4,706	2,232	$641	$7,199	2,577	$487	2,496	19,844	$2,703	9,411	$32,380
	New Construction	Standard heat pump	1,258	1,020	$238	$3,950	1,280	$242	1,249	2,871	$542	2,246	$10,386
		Natural gas, new AC	4,706	1,879	$197	$3,118	1,524	$288	1,474	8,572	$359	3,423	$13,467
		Heating oil, new AC	4,946	2,723	$353	$5,402	1,524	$288	1,474	9,581	$683	5,273	$15,545
		Propane, new AC	4,706	2,232	$641	$7,214	1,524	$288	1,474	8,572	$1,168	4,066	$20,832
HOUSTON	Retrofit	Standard heat pump, flat rate	1,258	1,590	$134	$3,686	7,337	$784	8,985	1,957	$209	2,532	$15,350
		Standard heat pump, Free Nights	1,258	1,590	$154	$3,860	7,337	$1,326	8,983	1,957	$139	2,532	$19,678
		Flexible heat pump, Free Nights	1,761	2,240	$48	$3,072	8,553	$1,287	10,486	2,570	$136	3,328	$19,286
		Natural gas, existing AC	4,706	1,879	$100	$2,141	8,918	$953	10,927	6,087	$130	2,431	$13,016
		Natural gas, new AC	4,706	1,879	$100	$2,141	8,205	$877	10,053	6,087	$130	2,431	$19,280
	New Construction	Standard heat pump, flat rate	1,258	1,590	$134	$2,979	3,615	$386	4,409	775	$83	1,001	$8,321
		Standard heat pump, Free Nights	1,258	1,590	$154	$3,157	3,615	$596	4,409	775	$71	1,001	$10,126
		Flexible heat pump, Free Nights	1,761	2,240	$48	$2,369	4,344	$562	5,314	756	$68	975	$11,382
		Natural gas, new AC	4,706	1,879	$100	$2,155	4,213	$450	5,145	2,343	$50	935	$12,899

ENDNOTES

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