Denver Regional Council of Governments Priority Climate Action Plan

March 2024

Prepared for the U.S. Environmental Protection Agency part of the State and Local Climate and Energy Program.

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From the executive director

Thank you for your interest in the Priority Climate Action Plan. The Denver Regional Council of Governments (also referred to as DRCOG) was awarded the U.S. Environmental Protection Agency's Climate Pollution Reduction Grant for the Denver-Aurora-Lakewood Metropolitan Statistical Area and prepared this Priority Climate Action Plan consistent with grant requirements.

The plan sets a vision for the greater Denver region's climate goals, describing eight near-term, high-priority, implementation-ready measures to reduce greenhouse gas emissions, improve air quality and drive equity in the Front Range.

The plan was prepared in partnership with staff and elected officials of local governments and with a robust public engagement process. The plan builds upon, accelerates and celebrates climate work across the Front Range.

I appreciate your interest in the Priority Climate Action Plan, and the contributions of the many residents of the region who shaped it through the various opportunities for public involvement.

Douglas W. Rex
Executive Director

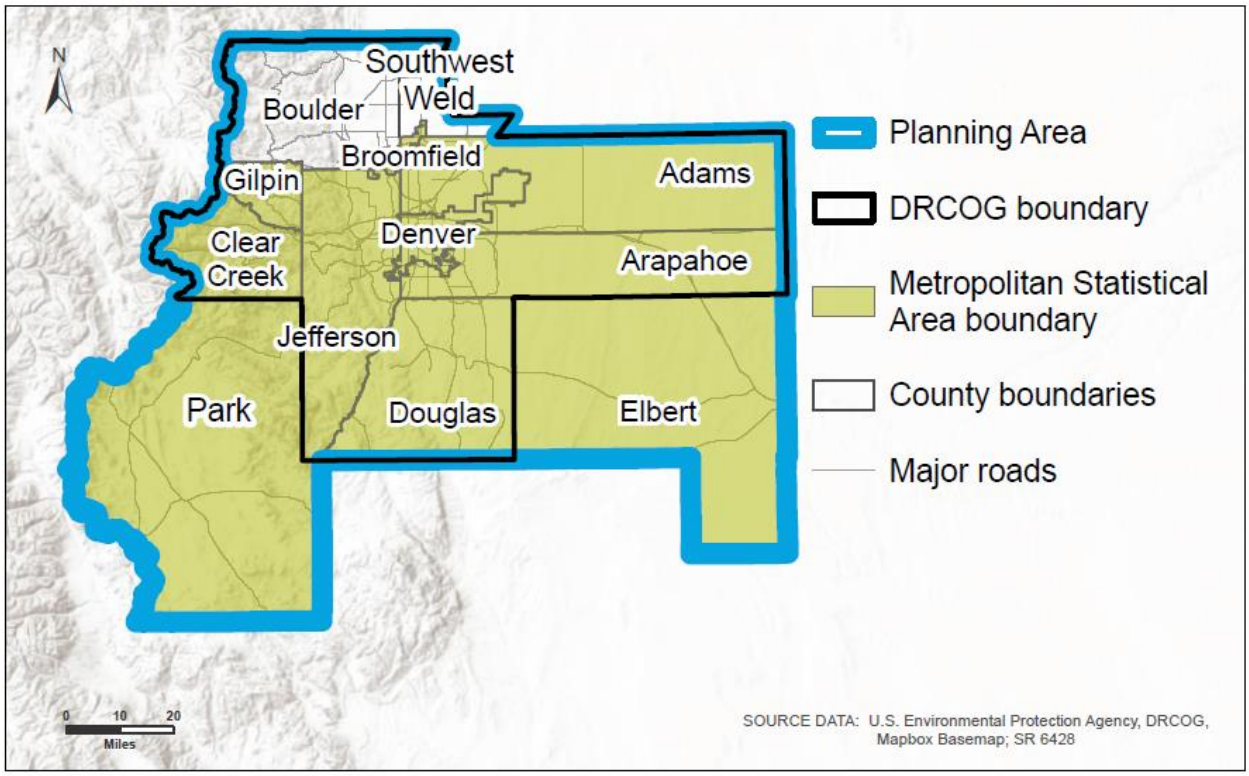
Denver Regional Council of Governments

Executive summary

Introduction

The Denver-Aurora-Lakewood Metropolitan Statistical Area received a $1 million planning grant to develop climate action plans as part of the Climate Pollution Reduction Grants program, an initiative of the U.S. Environmental Protection Agency. The Denver Regional Council of Governments (also known as DRCOG) is spearheading the climate action planning efforts, expanding the planning area to include Elbert County and Park County. This is referred to as the Climate Pollution Reduction Grant Planning Area (Figure 1).

Figure 1. *The Denver region's Climate Pollution Reduction Grant Planning Area.*



This Priority Climate Action Plan is the first deliverable for the Climate Pollution Reduction Grants program and includes a greenhouse gas inventory, a workforce planning analysis and climate pollution reduction measures, including an assessment of the positive effects the measures will have on low-income and disadvantaged communities and a review of the authority to implement the measures.

Public and stakeholder engagement

To ensure local community priorities were addressed, DRCOG staff convened three committees to facilitate this plan's creation — a project management team, a

stakeholder steering committee and an equity subcommittee. Additionally, DRCOG staff held two virtual public meetings and used a public engagement website to gather public feedback.

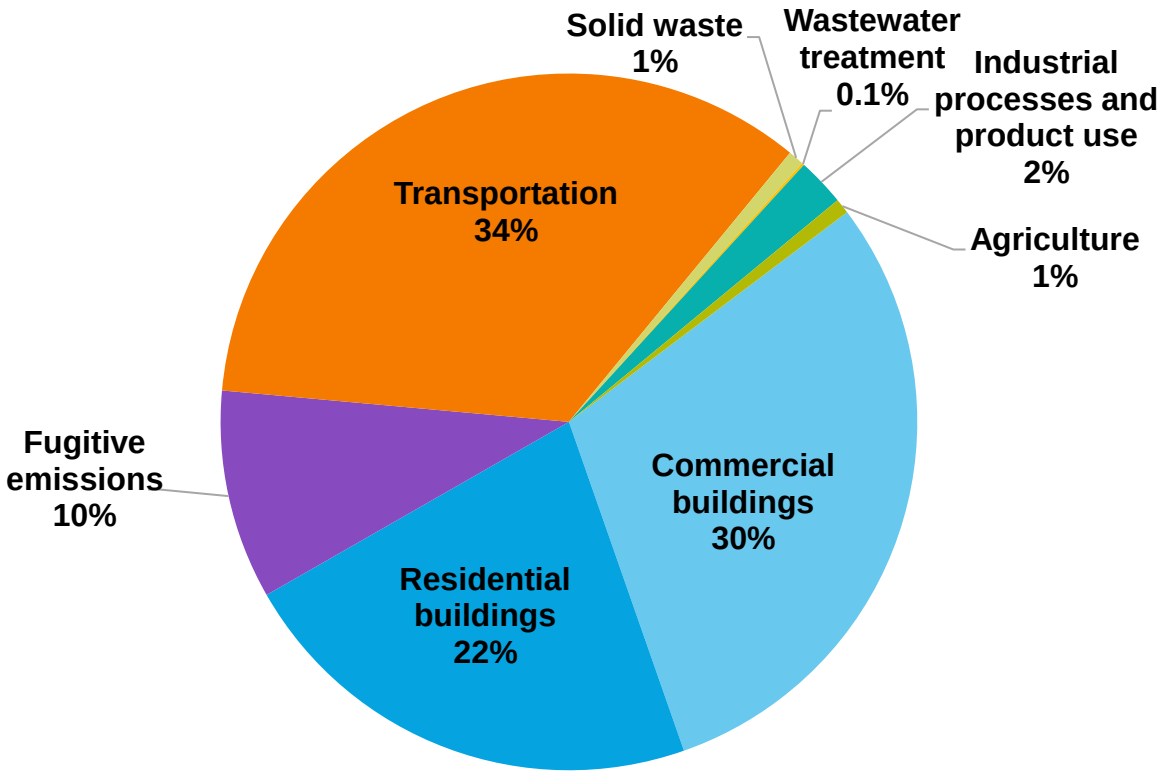
Greenhouse gas inventory

The 2022 greenhouse gas inventory for the Climate Pollution Reduction Grant Planning Area used the Global Protocol for Community Greenhouse Gas Emission Inventories, a standard framework for local and regional governments.

The inventory provides a quantitative assessment of greenhouse gas emissions from human activities, enabling policymakers and local government staff to understand the sources and magnitude of contributions to climate change. The assessment serves as a baseline for developing effective strategies to reduce emissions and track progress over time.

Within the Climate Pollution Reduction Grant Planning Area, transportation (34%), commercial buildings (30%) and residential buildings (22%) constitute a combined 86% of the area's emissions, depicted in Figure 4. Transportation emissions include those from roadway and off-road vehicles, aviation activities and railroads.

Figure 4. Emissions by sector (units are in metric tons of carbon dioxide equivalent). Source: Lotus Sustainability.



Climate pollution reduction measures

The plan includes eight detailed implementation-ready measures that will reduce climate pollution across the region. In alignment with the findings of the greenhouse gas inventory and vetted through public and stakeholder engagement, four of the measures address the building sector, two measures address the transportation sector, and two of the measures are supportive, essential for successful implementation. Beyond the brief summaries in this executive summary, full details for each measure are available in the "Climate pollution reduction measures" section of the plan.

Supportive measure No. 1:
Building energy improvement advisors program

- Trained advisors, administered through a regional agency, will guide home and building owners through a full suite of cost-saving decarbonization opportunities, including efficiency and electrification upgrades, financing, energy resiliency and rebates.

Supportive measure No. 2:
Workforce development

- Bring new workers into decarbonization trades and professions and upskill the current workforce by providing scholarships for industry-provided courses, on-the-job training, and certification. Enable training by providing supportive services such as child care, transportation to and from training facilities and offsetting lost wages.

Buildings implementation measure No. 1:
Commercial, multifamily, municipal, university, school, hospital building electrification and efficiency upgrades

- Subsidize and help commercial, multifamily, municipal, university, school, hospital and equity-priority buildings transition from fossil-fuel based systems to electric power.

Buildings implementation measure No. 2:
Multifamily property owners building decarbonization

- Support existing, large multifamily property owners in decreasing costs and climate pollution emissions through energy efficient and electrification upgrades.

Buildings implementation measure No. 3:
Residential building electrification and energy audits

- Help the region's residents upgrade and decarbonize their homes with as little hassle and cost as possible, prioritizing the most vulnerable residents.

Buildings implementation measure No. 4:
Free home weatherization and energy efficiency services for low-income disadvantaged communities

- Provide free weatherization and energy efficiency improvements to low-income and disadvantaged residents, while providing discounts and advice to assist all residents.

Transportation implementation measure No. 1:
Regional bus rapid transit expansion

- Complete an ambitious expansion of a regional bus rapid transit network by 2030, providing reliable, fast public transportation options, decreasing usage of single-occupant vehicles and vehicle miles travelled.

Transportation implementation measure No. 2:
Regional active transportation network expansion

- Expand and better connect the Denver region's active transportation network, reducing vehicle miles traveled and providing safe, connected travel options for active transportation modes.

Workforce planning analysis

As the Denver region's communities commit to reducing greenhouse gas emissions through the measures outlined in the plan, a skilled and adaptable workforce will be necessary to propel progress toward a clean energy economy. The plan's analysis outlines current workforce trends, challenges and opportunities within the Denver region.

Implementation and future steps

The Priority Climate Action Plan is a prerequisite for competing in the Climate Pollution Reduction Grants program's second phase for U.S. Environmental Protection Agency implementation grants. Successful implementation grant applications will rely on the plan to detail programs, policies, measures and projects.

DRCOG's role extends beyond planning, as DRCOG staff will facilitate collaboration and provide ongoing support for effective climate action. The agency's commitment to addressing climate change aligns with its mission to foster positive change and partnership in the Denver metropolitan area. Through participation in the Climate Pollution Reduction Grants initiative, DRCOG's staff and member governments will create a thriving, sustainable, and resilient Denver region, ensuring equitable access to opportunities and benefits for current and future generations.

Introduction

The most basic purpose of Metro Vision — the Denver Regional Council of Government's plan for continued success and improved quality of life in the Denver region — is to safeguard the region's many desirable qualities for coming generations. Climate change poses a fundamental threat to the region's shared vision for its future. From the local consequences of worsening air quality, flooding, wildfire and more frequent extreme heat to global conditions like diminished food supply and rising sea levels, the effects will reverberate both in the Denver region and across the globe.

At its core, the Denver region's Priority Climate Action Plan outlines an ambitious, interconnected set of voluntary strategies to mitigate climate change while addressing economic disparities. The plan prioritizes equitable access to benefits and ensuring that vulnerable communities receive a fair share of the opportunities arising from investment. The array of strategies offered in the plan are flexible, allowing for customization by local communities to meet their unique needs and priorities while encouraging and equipping local decision-makers to pursue both local and regional initiatives that will collectively affect the entire Denver region.

Through collective efforts, staff of DRCOG, its member governments and partner organizations creates a thriving, sustainable and resilient Denver region for the benefit of current and future generations.

Climate Pollution Reduction Grants program

Climate pollution refers to the release of emissions into the Earth's atmosphere that contribute to climate change. The substances, often referred to as greenhouse gases, trap heat in the atmosphere, leading to an increase in the Earth's average temperature. Human activities — particularly the burning of fossil fuels like coal, oil, and natural gas — are major sources of climate pollution. Large and increasing amounts of these emissions are creating an imbalance in the atmosphere, intensifying harmful changes to the Earth's climate.

Authorized under Section 60114 of the Inflation Reduction Act and administered by the U.S. Environmental Protection Agency, the Climate Pollution Reduction Grants program provides $5 billion in grants to states, local governments, tribes and territories to develop and implement ambitious plans to reduce climate and other harmful air pollution. The first phase of the program provides $250 million in noncompetitive planning grants to every state and the largest census-designated metropolitan statistical areas. The second phase designates approximately $4.6 billion in funding for competitive implementation grants. Through the program, the U.S. Environmental Protection Agency seeks to achieve three broad objectives:

- Tackle climate pollution while supporting the creation of good jobs and lowering of energy costs for families.
- Accelerate work to address environmental injustices and empower community-driven solutions in overburdened neighborhoods.
- Deliver cleaner air by reducing harmful air pollution in places where people live, work, play and go to school.

Through the Climate Pollution Reduction Grants program, the Denver-Aurora-Lakewood Metropolitan Statistical Area was allocated a $1 million planning grant to develop climate action plans in coordination with local stakeholders throughout the region. On April 19, 2023, with letters of support from several local government partners, the DRCOG Board of Directors voted unanimously to accept the role of lead agency for the region's Climate Pollution Reduction Grant. U.S. Environmental Protection Agency requirements dictate that the planning grant funds be designated for the completion of the following products:

- Priority Climate Action Plan, due March 1, 2024.
- Comprehensive Climate Action Plan, due Aug. 1, 2025.
- Status Report, due at the close of the 4-year grant period, due Aug. 1, 2027.

This Priority Climate Action Plan is the first deliverable to the Environmental Protection Agency under the Climate Pollution Reduction Grants program.

Priority Climate Action Plan

The Priority Climate Action Plan includes a list of near-term, high-priority, implementation-ready measures to reduce greenhouse gas pollution, as well as an

analysis of greenhouse gas emissions reductions that would be achieved through implementation. The plan must include:

- A **greenhouse gas inventory** to quantify and track the amount of greenhouse gases (carbon dioxide, methane, nitrous oxide) released into the atmosphere from human activities in the planning area.
- A list of **quantified greenhouse gas reduction measures** that achieve significant greenhouse gas reductions while considering other relevant planning goals.
- **A low-income and disadvantaged communities' benefits analysis** that assesses how the greenhouse gas reduction measures positively impact these communities, including, but not limited to, co-pollutant emissions reductions, increased climate resilience, improved access to services and amenities, jobs created, workforce development and reduced costs from energy efficiency improvements.
- **A review of authority to implement** the measures through existing statutory and regulatory authority, determining if such authority must still be obtained.

The Priority Climate Action Plan is a prerequisite for competing for implementation grants during the program's second phase. Applications for an implementation award under the Climate Pollution Reduction Grants program will rely on a Priority Climate Action Plan to describe the programs, policies, measures and projects the entity will carry out with the implementation grant funding.

As a regional planning agency with a long history of collaboration in the Denver region, the Denver Regional Council of Governments was well-suited to lead the Priority Climate Action Plan effort.

The Denver Regional Council of Governments

The Denver Regional Council of Governments (also referred to as DRCOG) serves as a planning organization, technical assistance provider and forum for local member governments, to foster positive change in the Denver metropolitan area. The DRCOG region includes vibrant, connected, lifelong communities with a broad spectrum of housing, transportation and employment complemented by world-class natural and built environments. The Denver region's Climate Pollution Reduction Program elevates the equity and overall well-being of local communities while reducing climate pollution.

As a regional agency, DRCOG can address climate change due to its unique position at the intersection of local government action and regional collaboration. As a regional agency, DRCOG will:

- Facilitate the **coordination and collaboration** of local governments, businesses and community organizations to ensure a cohesive and unified approach to climate action planning, while leveraging collective resources and avoiding duplication of efforts.
- Evaluate and **create strategies to reduce climate pollution** from regional systems like transportation and waste.
- Identify, promote and **support best practices** to reduce climate pollution.
- **Build bridges** among partner jurisdictions to overcome obstacles.
- **Provide policy guidance and advocacy** to support clean energy, sustainable development and emissions reductions for effective climate action.
- Collect regional climate data and **perform analyses** to help local governments better understand local vulnerabilities and develop targeted strategies.

Approach to developing the Priority Climate Action Plan

This Priority Climate Action Plan comprises implementation-ready measures that will reduce climate pollution across the region. To ensure local community priorities were addressed the Denver Regional Council of Governments staff created three committees to facilitate this plan's creation — the project management team, the stakeholder steering committee and the equity subcommittee.

This chapter outlines the process DRCOG staff followed to work with the committees to produce a meaningful process that supports the needs of local jurisdictions, effectively engages the public and fosters regional collaboration related to meaningful climate action.

Project management team

The project management team consists of five voluntary members, all of whom were experts in various environmental fields and represent various communities across the planning region. Team members leveraged their insights throughout the planning process through frequent one-on-one and group meetings with DRCOG staff beginning in May 2023. The project management team also participated in two in-depth strategy sessions with equity steering committee members on the first on November 13, 2023 and the second on November 30, 2023. The project management team's purpose was to discuss the strengths, opportunities, weaknesses and threats related to the Priority Climate Action Plan's creation.

Stakeholder steering committee

To ensure that the plan addressed broader local community priorities, DRCOG staff coordinated with jurisdictions to form a stakeholder steering committee. DRCOG led monthly, hour-long meetings for the stakeholder steering committee from May 2023 through February 2024. This group consisted of roughly 60 municipal staff from the planning area. During 10 meetings, DRCOG staff gathered insight about the plan and implementation grants.

During discussions in the spring of 2023, stakeholder steering committee members considered how the $1 million dollar planning grant would be administered and identified public engagement priorities to be pursued throughout the planning process. In the fall, DRCOG leadership hired a senior planner and consultant, and work began on the requirements for the plan. Stakeholder steering committee members were instrumental in providing feedback throughout the fall. The stakeholder steering committee discussed 16 strategies and helped finalize the eight measures for the plan. Finally, in early January 2024, the committee met to discuss two potential implementation grant concepts, with discussion about the right option for the region.

Equity subcommittee

A guiding principle of DRCOG's public engagement plan is the incorporation of perspectives from marginalized groups and low-income or disadvantaged communities in the planning process. Some examples include, but are not limited to, those whose first language is not English, individuals representing diverse cultural backgrounds, low-income individuals, individuals that are hard of hearing, young adults and those with disabilities. DRCOG staff considered feedback from marginalized individuals and groups to be essential to building a successful and meaningful Priority Climate Action Plan.

Selection for the equity subcommittee began meeting in early fall 2023. Its first step was to create a spreadsheet of 48 organizations that fit into at least one of 25 categories:

- Affordable housing.
- African American community.
- Agriculture.
- Air quality.
- Asian community.
- Asian American community.

- Business.
- Disabilities.
- Houseless community.
- Indigenous community.
- People of color.
- Conservation.
- Energy.
- Faith-based community.
- Latino community.
- Manufactured homes.
- Native American community.
- Public health.
- Small business.
- Students.
- Transportation.
- Workforce.
- Youth.

After DRCOG staff conducted outreach, it selected six individuals for the equity subcommittee. Their organizations and backgrounds including the following categories: affordable housing, African American communities, Asian communities, conservation, faith-based organizations, Native American communities and Indigenous communities, and youth. Committee members attended four virtual meetings and two public outreach meetings. Additionally, two co-chairs from the equity subcommittee joined the project management team brainstorming workshops in November 2023 and the implementation workshop in January 2024 to ensure that equity considerations and opportunities were incorporated into development of the final Priority Climate Action Plan strategies and implementation details. DRCOG staff consider the input equity committee members provided to be invaluable throughout the planning process and plan creation.

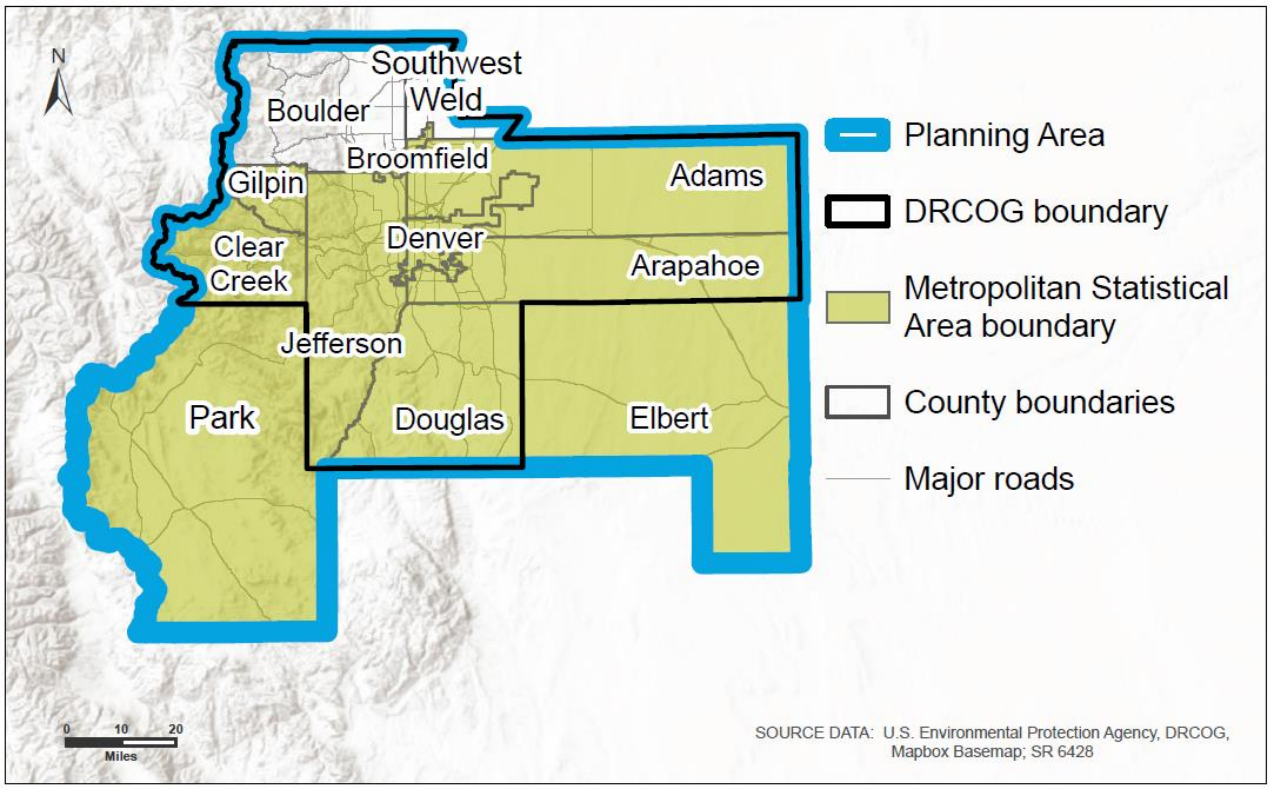
Implementation workshop

DRCOG hosted an in-person, half-day workshop on Jan. 11, 2024, with more than 50 stakeholders in attendance. Attendees self-selected their interest in representing the following strategy topic areas: implementing agencies and partners, geographic reach, timeline, program gaps and considerations and the role of DRCOG in implementation. DRCOG staff then compiled and analyzed the feedback to inform plan development

The Denver region's Climate Pollution Reduction Grant Planning Area

The U.S. Environmental Protection Agency designated the Denver-Aurora-Lakewood Metropolitan Statistical Area as a grant recipient under the Climate Pollution Reduction Grants Program. The U.S. Census Bureau defines metropolitan statistical as a county or group of counties that have at least one urbanized area with a population of 50,000 or more and include adjacent counties that have economic ties to the central area. After consultation with stakeholders, the Denver Regional Council of Governments staff defined the Climate Pollution Reduction Grant Planning Area as the entire Denver-Aurora-Lakewood Metropolitan Statistical Area, expanded to include Boulder County and Southwest Weld County. The extension encompasses the entirety of the Denver region. A map of the planning area is shown in Figure 1.

Figure 1. *The Denver region's Climate Pollution Reduction Grant Planning Area. Source: DRCOG, U.S. Census.*



The resulting boundary includes over 20 local jurisdictions that have organizational goals to reduce greenhouse gas emissions. Additionally, the State of Colorado's Greenhouse Gas Pollution Reduction Roadmap outlines a pathway to meet the state's science-based climate targets to reduce greenhouse gas emissions by 26% by 2025, 50% by 2030 and 90% by 2050 from 2005 levels.

Approach to engaging low-income, disadvantaged communities

Denver Regional Council of Governments staff recognize their role in building and maintaining an equitable region where all residents and communities thrive. By adopting Metro Vision, DRCOG's Board of Directors affirmed its commitment to ensure the region remains a diverse network of vibrant, connected and lifelong communities — particularly in light of a global climate crisis. DRCOG staff recognize the importance of including and elevating the voices of marginalized groups in the creation of the Priority Climate Action Plan. Accordingly, DRCOG staff considered the potential benefits and burdens on low-income or disadvantaged communities and formed an equity subcommittee to amplify the voices of those communities in guiding the planning process. The equity subcommittee included a diverse representation of stakeholders outlined in the "Equity subcommittee" section.

The Climate Pollution Reduction Grants program is an opportunity to support marginalized communities while addressing nuanced challenges associated with climate pollution. As stakeholders developed the plan, they paid special attention to opportunities to provide direct monetary, health, social and economic benefits to residents in low-income and disadvantaged communities.

Under the Climate Pollution Reduction Grants program, DRCOG staff was tasked with the following requirements:

- Identify low-income and disadvantaged communities through the Environmental Protection Agency's Climate and Economic Justice Screening and Environmental Justice Screening and Mapping tools.
- Conduct meaningful public engagement with communities identified.
- Quantify benefits and burdens of identified climate pollution reduction measures to identified communities.

Identification of low-income and disadvantaged communities

To identify low-income and disadvantaged geographies, DRCOG used the U.S. Environmental Protection Agency's Climate and Economic Justice Screening Tool and its Environmental Justice Screening and Mapping Tool (often referred to as EJScreen).

The Climate and Economic Justice Screening Tool uses datasets that are indicators of burdens in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development to identify low-income and disadvantaged communities. The workforce development category includes indicators for low median income and poverty. The tool ranks most of the burdens using percentiles by census tract. Percentiles show how much burden communities within each tract experience compared to other tracts. To qualify as a disadvantaged community in the Climate and Economic Justice Screening Tool, at least one of the

burden indicators must be above the 90th percentile compared with the rest of the nation.

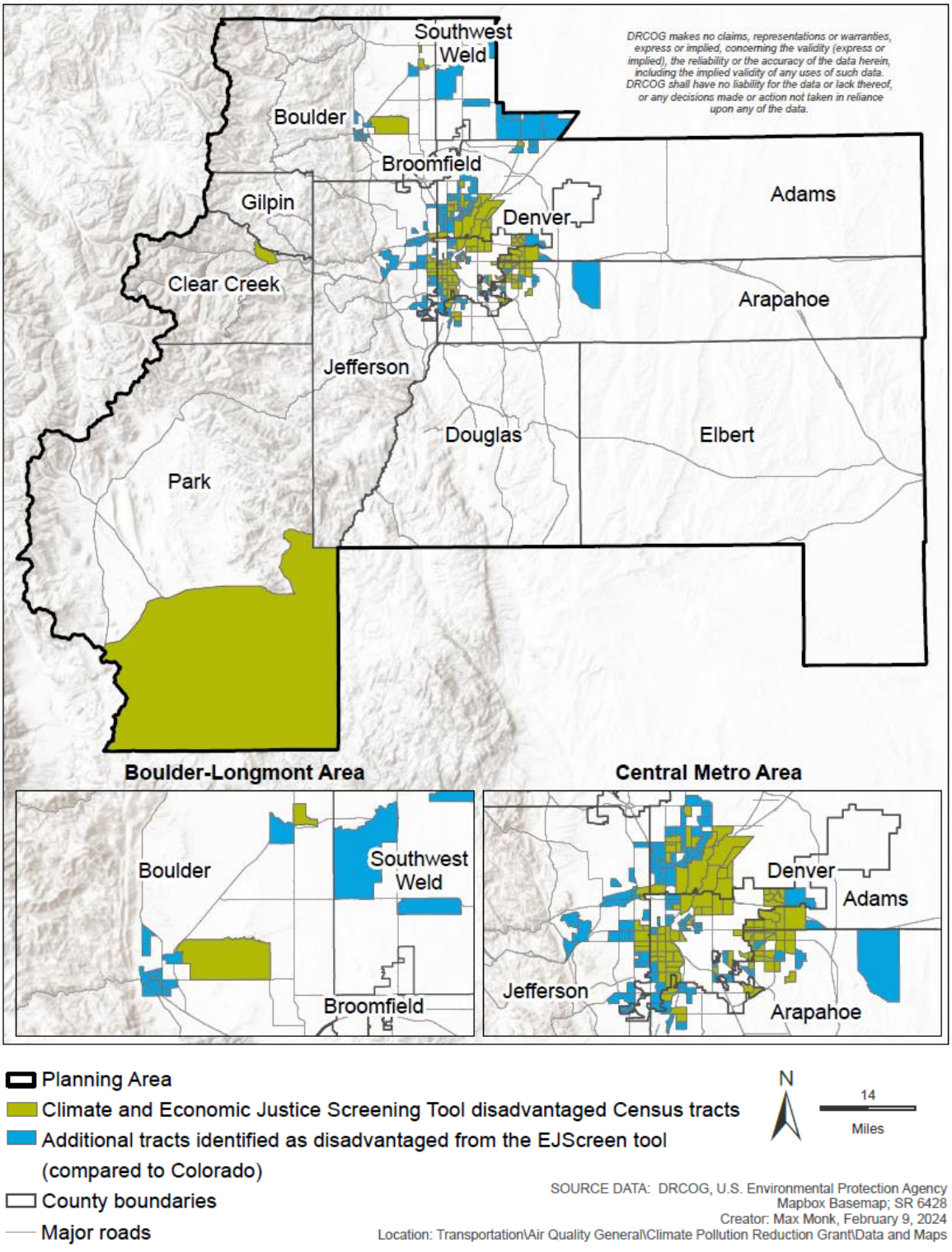
EJScreen is the agency's environmental justice mapping and screening tool that uses national datasets for environmental and socioeconomic indicators to identify low-income and disadvantaged communities. EJScreen operates at a finer geographic scale of census block groups than the Climate and Economic Justice Screening Tool, which relies on census tracts. EJScreen's finer scale uses supplemental indices to identify smaller areas that may be disadvantaged within a larger area that would not have been identified otherwise. DRCOG staff selected EJScreen block groups that were above the 90th percentile compared with the rest of Colorado for any of the environmental or socioeconomic indicators.

Figure 2 depicts the location of the Climate and Economic Justice Screening Tool and EJScreen tracts identified within the planning region. After analyzing demographic data for identified tracts, DRCOG staff found that the Planning Area's low-income, disadvantaged communities comprise nearly **934,000 people**, representing approximately **28% of DRCOG's entire population** and **42% of DRCOG's people of color population** (per the U.S. Census 2022 5-year estimates).

DRCOG staff conducted engagement with disadvantaged communities during four meetings of the equity subcommittee and the strategies outlined in the "Public engagement" section. Staff also examined whether measures identified in the plan provided expected burdens and benefits to disadvantaged communities as outlined in the Climate Pollution Reduction Measures section of this plan.

DRCOG staff equitably address the needs of every community in the region and will continue community engagement during development of the Comprehensive Climate Action Plan. As part of the second planning phase, DRCOG staff will continue to engage with and amplify the perspectives of low-income or disadvantaged communities to ensure the plan addresses their needs.

Figure 2. *Identified low-income and disadvantaged Census tracts. Source: The U.S. Environmental Protection Agency's Climate and Economic Justice Screening and EJScreen tools.*



Public engagement

Overview

Denver Regional Council of Governments staff considered public and stakeholder engagement to be fundamental to the development of the region's Climate Pollution Reduction Grant Priority Climate Action Plan. The plan represents the input of four distinct groups: the stakeholder steering committee, equity subcommittee, project management team and the public. Over the six-month process of developing the plan, staff wove diverse and intentional engagement into interactions with group members. Each team or committee's purposes complemented the others.

Public engagement meetings

A total of 129 community members joined two virtual public meetings, one each on November 8, 2023, and December 11, 2023. DRCOG staff held the meetings to inform the public and receive feedback about the region's Climate Pollution Reduction Grant program.

The first meeting covered a general overview of the Climate Pollution Reduction Grant program. Staff facilitated initial feedback through interactive polling and by providing an opportunity for community members to ask questions about the program. According to staff, key insights gained from the public at the first meeting included the need to ensure that any programs and strategies that will result in new job opportunities focus on the creation of high-paying, respectable careers for low-income and disadvantaged community members, and that community-based organizations should be involved in the development and implementation of programs to encourage broad community participation and receive a large share of the benefit.

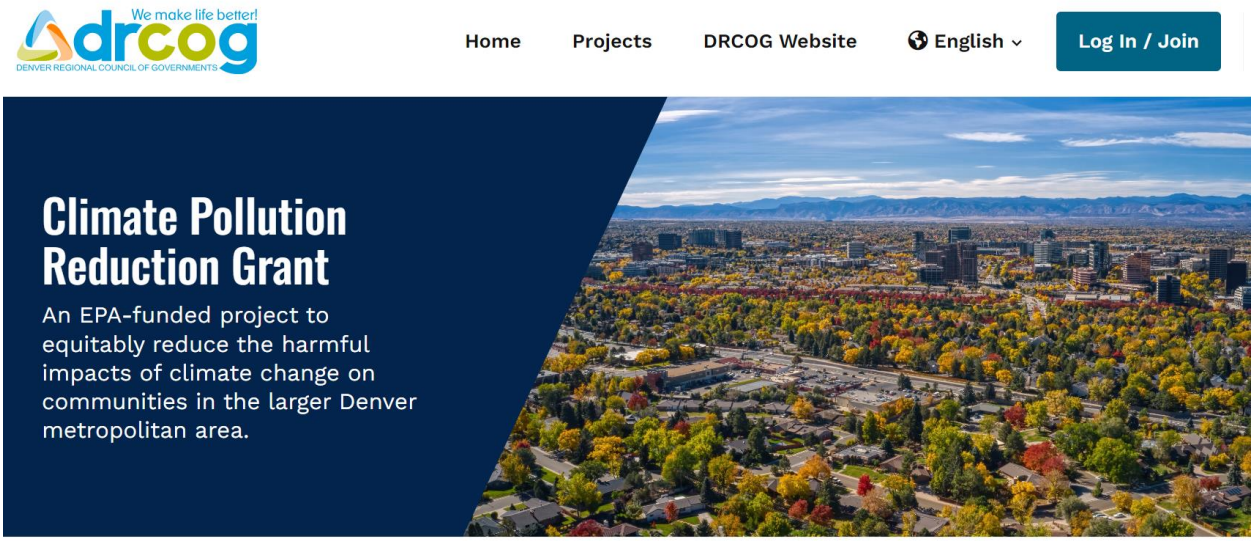
At the second meeting, staff presented the eight Priority Climate Action Plan strategies to the public meeting attendees. The strategies, discussed in detail in the Climate Pollution Reduction Measures section of the plan, focus on two sectors, buildings and transportation, which garnered the highest interest from stakeholder groups. Participants shared ideas on how to improve equity during implementation of the plan's strategies. Within the building strategies, equity considerations included employing a centralized program that leverages community input, unified grant and rebate applications, and priority support for new businesses providing services as well as communities that have few existing resources for efficiency and electrification.

Within mobility strategies, community participants suggested improving connectivity across the transit system, improving infrastructure to connect transit access with active transportation options like walking and biking and enhancing micromobility options and electric vehicle charging for low-income, disadvantaged communities.

Social Pinpoint

Staff used Social Pinpoint, a public engagement software platform, to provide the public with updates about the Climate Pollution Reduction Grant program process, timelines and documents. Staff used the site's discussion board to solicit feedback about development of Priority Climate Action Plan measures.

Between October 2023 and February 2024, 1,662 people visited the Social Pinpoint site and provided 25 comments.



Social media posts

Staff used social media campaigns to promote virtual public engagement meetings and encourage the public to use the Social Pinpoint engagement site. Through social media campaigns, staff announced opportunities to provide feedback and comment on the development of the Priority Climate Action Plan and provided updates on the planning grant's progress. All campaigns incorporated still images and flyers in both English and Spanish. The combined reach of the 20 Facebook posts, 10 X (formerly known as Twitter) posts, 6 Instagram posts and 9 LinkedIn posts resulted in a total of 10,434 impressions during the public comment period. Social media users clicked on or reacted to posts over 240 times with an average engagement rate of 2.3%. In addition to inviting the public to explore the planning information through public meetings and Social Pinpoint, DRCOG staff also developed a website landing page with stakeholder meeting materials and links to the Social Pinpoint engagement site.

Summary

DRCOG's staff invites and considers the perspectives of individuals traditionally underrepresented in planning processes when creating this engagement plan. Staff's goal of providing multiple engagement channels (social media campaigns, public engagement, a dedicated public engagement website, and one-on-one meetings) was

to provide ample opportunities for all individuals to be heard. Stakeholder and public participation throughout the planning process laid the foundation of success for this plan.

Greenhouse gas emissions inventory

Regional greenhouse gas inventory and emissions sectors

A greenhouse gas inventory is a historical accounting of the quantity of greenhouse gases emitted to, or removed from, the atmosphere during a specific time period from various economic sectors. The greenhouse gas inventory covered in this section complies with the Global Protocol for Community Greenhouse Gas Emission Inventories. The inventory includes a mix of measured and estimated activity data for the year 2022. Staff calculated emissions for stationary energy (emissions associated with generating electricity; or energy generation as part of manufacturing and construction activities); transportation; fugitive emissions (unintentional and undesirable emission, leakage or discharge of gases or vapors from pressure-containing equipment or facilities and components inside plants such as valves and piping) and oil and gas activity; waste and wastewater; industrial processes and product use; and agriculture, forestry, and other land uses. The greenhouse gases included in the inventory cover carbon dioxide, methane, nitrous oxide and hydrofluorocarbons. This section of the plan includes an overview of sources, methodology and results from the inventory. Table 1 below lists the emission sectors and all sources within each sector.

Table 1. *Denver regional 2022 greenhouse gas inventory sector descriptions.*

Inventory sector	Description
Agriculture, forestry and other land uses.	The agriculture, forestry and other land uses sector includes emissions from livestock, emissions from urea fertilization and manure, and emissions from soil fertilizers and chemicals. Carbon emissions and removals from forests and urban trees are also included in this sector.
Fugitive emissions and oil and gas activity.	Fugitive emissions from natural gas leakage and process emissions from oil and natural gas activity in the region make up this sector.
Industrial processes and product use.	Refrigerant leakage and emissions from industrial facilities (such as gas plants, refineries and mining operations) are included in this sector.
Stationary energy.	Electricity generation.

	Xcel Energy. • CORE Electric Cooperative. • United Power. • Poudre Valley Rural Electrification Administration. • Longmont Power and Communications. Natural gas. • Xcel Energy. • Black Hills Energy. • Colorado Natural Gas. Staff also estimated usage data for stationary diesel and propane for this sector.
Transportation.	Data for fossil fuel vehicles, electric vehicles, gas-powered and electric public transit buses, light rail and commuter rail, railway activity, jet fuel and aviation gas for airplanes, and fuel usage for off-road vehicles and equipment are included in this sector.
Waste and wastewater.	This sector accounts for fugitive and process emissions from wastewater treatment, as well as emissions from septic tanks.

Methodology and sources

DRCOG staff prepared the regional inventory for the entire Climate Pollution Reduction Grant planning area by combining data from the following 12 counties in the Denver region and its surrounding area: Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Douglas, Denver, Elbert, Gilpin, Jefferson, Park and the southwest portion of Weld. This portion of Weld County, referred to as “Southwest Weld County,” includes the

municipalities of Dacono, Firestone, Frederick, Lochbuie, Mead, Platteville, half of Fort Lupton, as well as the Weld County portions of Erie and Longmont.

The Global Protocol for Community Greenhouse Gas Emission Inventories provides a transparent and consistent greenhouse gas accounting methodology for reporting community greenhouse gas emissions from carbon dioxide, methane, nitrous oxide, hydrofluorocarbons and other greenhouse gases. This report's inventory was developed in compliance with the Greenhouse Gas Protocol's BASIC reporting level, using relevant BASIC+ emissions reports.

Agriculture, forestry and other land uses

DRCOG staff used the Environmental Protection Agency's State Inventory Tool Agricultural Module and the U.S. Department of Agriculture 2017 Agricultural Census to calculate emissions from agriculture and land use. Staff used the Land Emissions and Removals Navigator to calculate carbon emissions and removals from forests and urban trees.

Fugitive emissions and oil and gas activity

Fugitive emissions data is calculated based on the activity data provided by natural gas utilities. Staff used activity data from the Colorado Oil and Gas Commission to calculate emissions from oil and gas operations.

Industrial processes and product use

Staff used commercial square footage data from each county's assessor's offices and the Intergovernmental Panel on Climate Change's 2019 Guidance for Greenhouse Gas Inventories to estimate refrigerant leakage. Staff used industrial facility data from the Environmental Protection Agency's Facility Level Information on Greenhouse Gases Tool.

Stationary energy

Stationary energy is energy consumed within unmoving objects and buildings such as homes and offices. It primarily includes electricity and heating fuel but can also include other fuels like diesel or propane. All utilities listed in Table 1 serve residents of the Denver region. Utilities provided the electricity and natural gas activity data necessary to calculate stationary energy emissions. In most cases, activity data from the utilities was derived from the site of the consumption, for example, the customer or premise. Staff calculated transmission and distribution losses using state-specific data from the U.S. Energy Information Administration. Additional activity data was provided for propane and stationary diesel by FerrellGas and the Colorado Department of Public Health and Environment, respectively.

Transportation

Staff calculated emissions for gasoline, diesel and ethanol vehicles using vehicle-miles-traveled (the amount of travel for all vehicles in a geographic region over an annual period) data from Google Environmental Insight Explorer; vehicle type breakdowns from

the Colorado Department for Health and Environment; and vehicle registration data from the Colorado Department of Revenue. Staff used the EValuateCO Dashboard for electric vehicle data.

Fuel usage, electricity usage and route data from the Regional Transportation District is provided for public transit, light rail and commuter rail calculations. The Environmental Protection Agency provided emissions data for freight railway activity. Staff collected data from the National Emissions Inventory for off-road vehicles and equipment. All regional airports directly provided airport fuel use data.

Waste and wastewater

The Environmental Protection Agency's Facility Level Information on Greenhouse Gases Tool provides landfill emissions data. When preparing the inventory, staff accounted for all major landfills in the Denver region. Staff used a population-based approach to calculate fugitive and process emissions for wastewater. Various county public health departments provided septic tank data.

2022 greenhouse gas emissions inventory results

The Denver region's greenhouse gas emissions totaled 44,443,010 metric tons of carbon dioxide equivalent in 2022. The total net carbon removed from the atmosphere by trees and forests, or "removals," totaled 854,036 metric tons of carbon dioxide equivalent. Subtracting the removals from the total carbon emissions leaves 43,588,974 metric tons of carbon dioxide equivalent; representing the Climate Pollution Reduction Grant planning area's net greenhouse gas emissions for 2022.

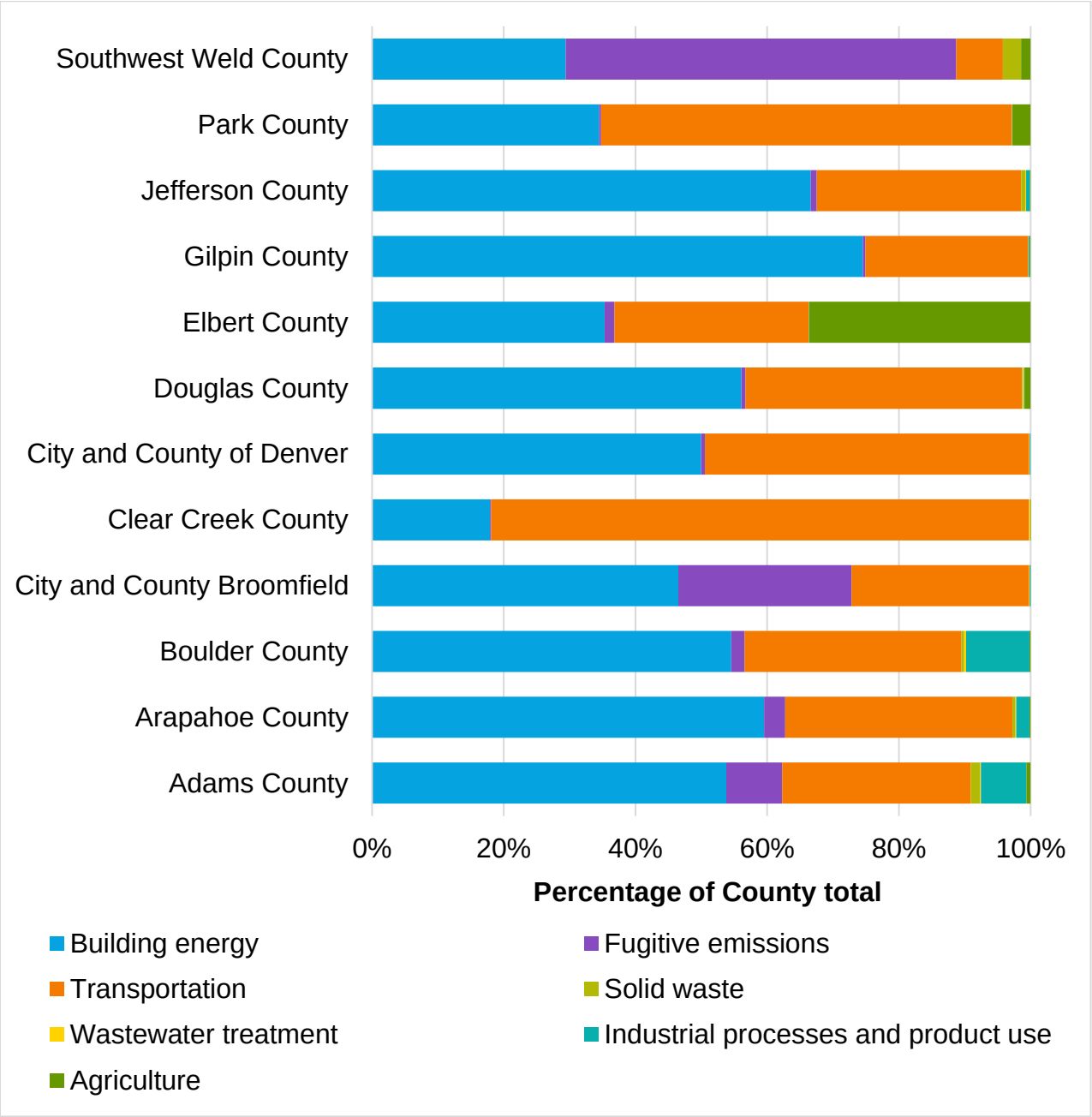
Results by county

Breaking total emissions into sectors helps elected officials and local government staff develop policies and strategies that can directly reduce the emissions-generating activity or source. Figure 3 divides emissions by county and sector. For most counties, the two largest emissions sectors are building energy use and transportation. Southwest Weld County has a high proportion of emissions from oil and gas activity due to the concentration of such operations within the county. Clear Creek County has a higher proportion of transportation emissions due to its small population but relatively high number of visitors who travel to and through the county as tourists. Other notable county metrics include Elbert County and its large share of agricultural emissions, as well as the significant proportion of emissions from industrial facilities in Adams, Arapahoe and Boulder counties.

Table 2. *Denver regional 2022 greenhouse gas inventory total emissions, removals and net emissions by county. Emission totals may differ from a county's publicly reported greenhouse gas emissions due to the regional methodology of this inventory.*

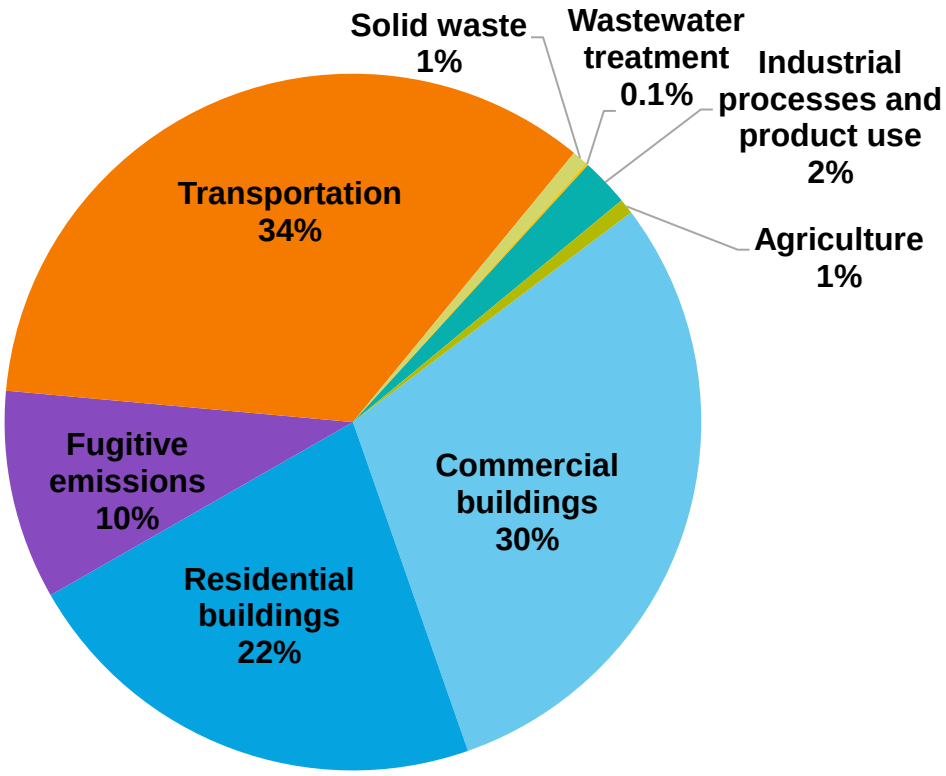
County	Total emissions (metric tons of carbon dioxide equivalent)	Removals (metric tons of carbon dioxide equivalent)	Net emissions (metric tons of carbon dioxide equivalent)
Adams County	6,974,204	4,409	6,969,795
Arapahoe County	6,409,870	13,010	6,396,860
Boulder County	3,404,118	157,429	3,246,689
City and County of Broomfield	972,128	777	971,351
Clear Creek County	471,598	98,413	373,185
City and County of Denver	10,402,538	7,874	10,394,664
Douglas County	4,404,652	102,851	4,301,801
Elbert County	361,233	N/A	361,233
Gilpin County	131,778	56,893	74,885
Jefferson County	5,482,362	180,349	5,302,013
Park County	287,631	231,561	56,070
Southwest Weld County	5,140,899	470	5,140,428
Total	**44,443,010**	**854,036**	**43,588,974**

Figure 3. *Emissions by sector percentage breakdown for all counties. Source: Lotus Sustainability.*



Totaling county emissions demonstrates that the largest emission sector is transportation at 34% of total emissions. Commercial building energy use and residential building energy use come next at 30% and 22%, respectively. Fugitive emissions follow at 10% of total emissions. The remaining sectors make up approximately 4% of total regional emissions. This emissions makeup is depicted in Figure 4.

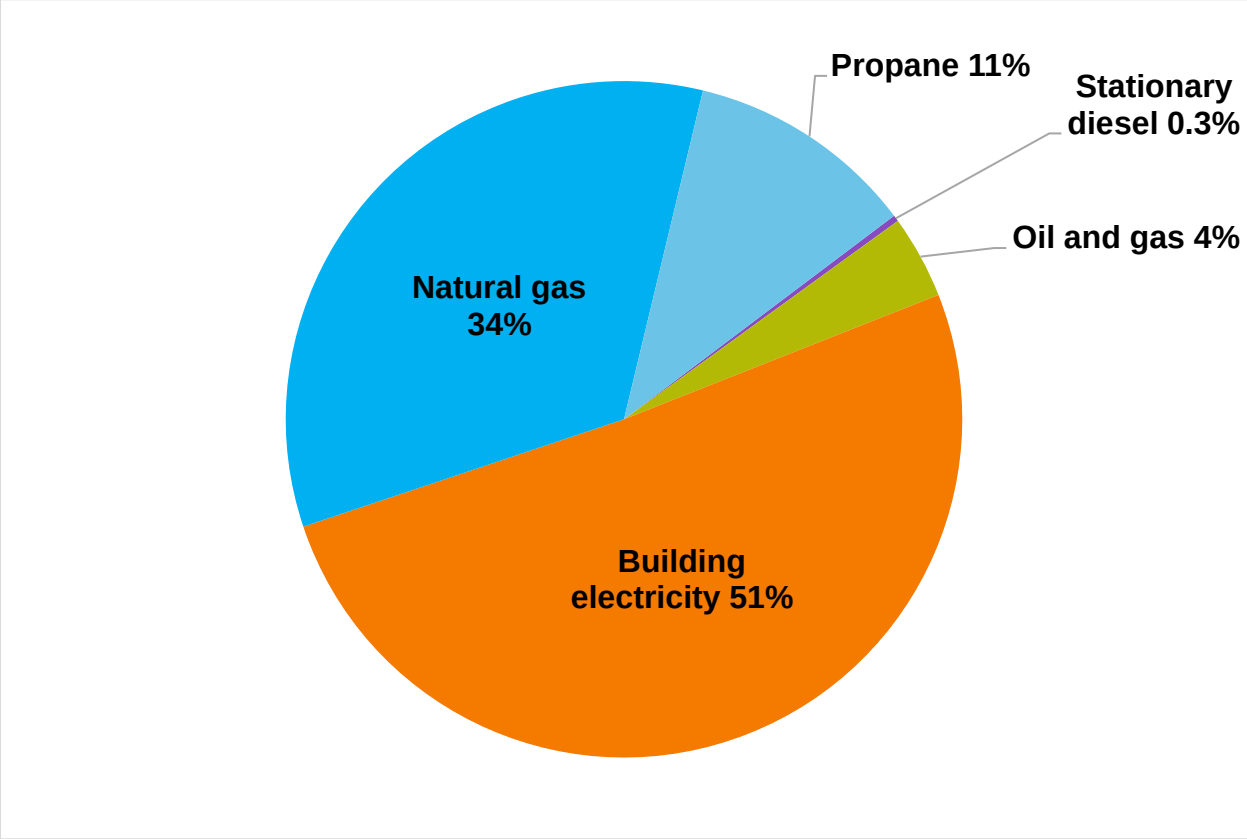
Figure 4. *Emissions by sector (units are in metric tons of carbon dioxide equivalent). Source: Lotus Sustainability.*



Stationary energy sector

Within the stationary energy sector, building electricity use accounts for the largest share of emissions at 52%. Natural gas use and associated fugitive emissions follow next at 34%. Propane emissions make up 11%, oil and gas activity make up 4%, and stationary diesel use makes up less than 1%.

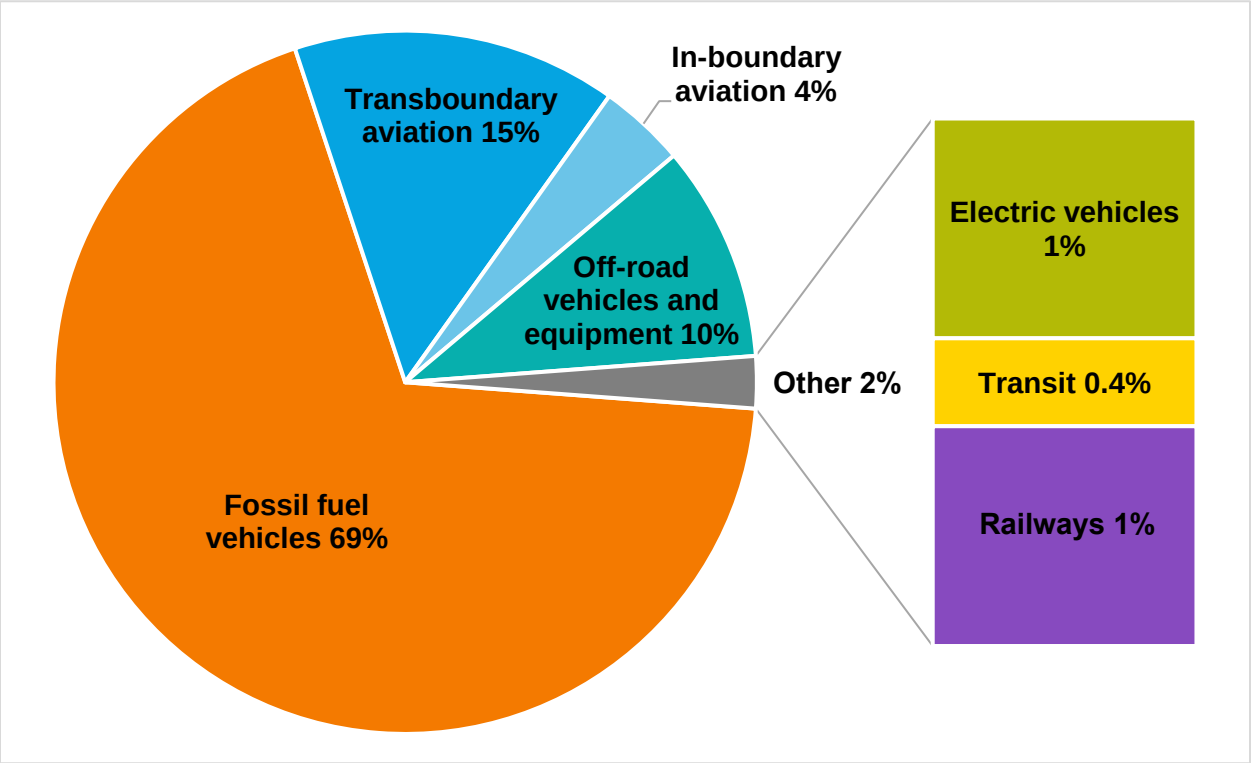
Figure 5. *Stationary energy sector percentage breakdown (metric tons of carbon dioxide equivalent). Source: Lotus Sustainability.*



Transportation sector

In the transportation sector, on-road vehicles with internal combustion engines result in the largest share of emissions at 69%. The next-largest sources of emissions are transboundary aviation (or flights that go into or out of the region's airports) at 15%, off-road vehicles and equipment like construction vehicles and lawn and garden equipment at 10%, and in-boundary aviation (or flights that take-off and land at the same regional airport) at 4%. The remaining sources in this sector make up approximately 2% of transportation emissions. Emissions from electric vehicles and railways each generate 1% and transit emissions account for less than 1%.

Figure 6. *Transportation sector percentage breakdown (metric tons of carbon dioxide equivalent). Source: Lotus Sustainability.*



Remaining sectors

Waste and wastewater account for just over 1% of total emissions, with landfill waste emissions generating 87% and wastewater treatment emissions accounting for 13% of the sector's emissions. Industrial processes and product use accounts for 2% of total regional emissions with emissions from industrial facilities making up 60% and refrigerant leakage emissions making up 40% of the sector's emissions. The agriculture, forestry and other land uses sector comprises almost entirely of emissions from agriculture practices; emissions from forestry and trees make up less than 1% of the sector. The sector also includes 854,036 metric tons of removed carbon from trees and forests.

Climate Pollution Reduction Measures

As demonstrated in the Public Engagement section of the plan, Denver Regional Council of Governments staff used extensive public and stakeholder engagement efforts to select and refine the following eight climate pollution reduction measures. Along with considerable engagement, staff shaped the measures in the context of a metropolitan planning organization's purpose and abilities. Stakeholders and staff discussed policy and its importance but because DRCOG cannot enforce policy it is not specifically called out in the eight measures.

Other key factors influenced the stakeholder group's selection of the final eight measures, including the greenhouse gas inventory which demonstrates that over 52% of total greenhouse gas emissions come from the building sector and over 34% from the transportation sector. Both sectors can be greatly influenced by regional and local agencies.

In selecting the eight measures, DRCOG staff factored in the plan's timing and budget constraints. DRCOG staff looks forward to engaging with the public and stakeholders through the Comprehensive Climate Action Plan to explore the remaining five sectors (electric power, agriculture, natural and working lands, industrial sector, and waste and material management). Each of the following eight measures is described in further detail in this chapter:

Supportive measures

1. Comprehensive building electrification and efficiency upgrade assistance.
2. Workforce development.

Building implementation measures

1. Commercial, multifamily, municipal, university, school, hospital building electrification and efficiency upgrades.
2. Multifamily property owners building decarbonization.
3. Residential building electrification and energy audits.
4. Free home weatherization and energy efficiency services: low-income disadvantaged communities.

Transportation implementation measures

1. Regional bus rapid transit expansion.
2. Regional active transportation network expansion.

Supportive measures

The first two climate pollution reduction measures create a supportive foundation for the remaining six implementation measures. While the measures do not independently reduce climate pollution, the two strategies are foundational to streamlining and facilitating other implementation measures identified in the plan.

Supportive measure No. 1:
Building energy improvement advisors program

Trained advisors, administered through a regional agency, will guide home and building owners through a full suite of cost-saving decarbonization opportunities, including efficiency and electrification upgrades, financing, energy resiliency and rebates.

The Building energy improvement advisors program will administer the buildings implementation measures identified in the plan. It will support all jurisdictions within the Climate Pollution Reduction Grant Planning Area in implementation, be a singular point of contact for participants in the program, provide energy advice and assistance for all supported programs, and coordinate with workforce partners to deploy the program. It will also facilitate and track energy audits, energy efficiency and electrification programs, and financing and rebates for residential, multifamily and commercial buildings.

Low-income disadvantaged communities benefits

- Support home renters and owners to improve energy efficiency and electrify their homes and decrease energy costs.
- Proactively target assistance in navigating home electrification/efficiency upgrades and rebates in identified low-income disadvantaged communities.
- Reduce confusion for residents and businesses who require energy support on where to obtain assistance.
- Track impact data for the planning area, including greenhouse gas savings, energy bill impacts and upfront cost impacts to help the region's residents, member government staff and elected officials better understand the economics of electrification and efficiency on varying home types.
- Align rebate requirements to help simplify rebate applications for contractors and residents.
- Marketing and outreach specialized and prioritized in low-income disadvantaged communities only.
- Direct rebates for low-income disadvantaged communities only.
- Specific marketing and outreach to low-income disadvantaged community's rental and homeowners.
- Iterative feedback from low-income disadvantaged community members to continuously improve program.

Costs

Costs associated with providing a comprehensive assistance program are based on several data sources. The first data source estimates the total staff needed to support the program in implementing the buildings sector measures in the plan. Staff used an economic multiplier to determine how many administrative jobs would be needed to operate this program – that multiplier was found to be 3.62 jobs per million U.S. dollars to successfully implement the measures through the program. The total jobs required to run the program fluctuate with the federal, state and local funding these programs receive between 2024 and 2035.

Average wages and salaries for the staff required to run the program were estimated using data from the 2022 Colorado Department of Labor and Employment report under the general and administrative staff and in-field staff from comparable local and state agencies. The U.S. Bureau of Labor and Statistics estimates that benefits are 38.1% of salary, and staff factored benefits into the cost per employee.

Costs are estimated at the high and low ends of investment and are depicted in Table 3. The high end represents the total investment in buildings implementation measures in a high adoption scenario. The low end represents the total investment in the same for a low adoption scenario.

__Table 3.__ Cost to administer a comprehensive building electrification and efficiency upgrade assistance program for the buildings implementation measures in a high and low adoption scenario. Source: Lotus Sustainability.

Strategy	Cost value	Cumulative costs (high end)	Cumulative costs (low end)
Program execution	General and administrative staff	$31.6 million	$12.5 million
Program execution	In-field staff	$174.8 million	$69.3 million
Program execution	Average benefit Markup	$127.1 million	$50.4 million
Program execution	Average overhead markup	$98.7 million	$39.1 million
Program execution	**Total costs**	**$432.4 million**	**$171.4 million**

Greenhouse gas impact

This measure will support the buildings implementation measures, but it does not have a direct, associated greenhouse gas reduction.

Co-pollutant impacts

This measure will support the buildings implementation measures, but it does not have a direct, associated co-pollutant reduction.

Implementation timeline and milestones

2025

- Coordinate with the City and County of Denver's Healthy Homes Program.
- Coordinate and align rebates regionally.
- Make single rebate applications available to contractors through the program.

2026

- Local governments coordinate to sign a memorandum of understanding to establish funding contributions for the program.
- Program expansion begins for central administration and rebates.

2026 through 2029

- Execute centralized program management and strategy.
- Focus on reducing redundancy and coordinating between current incentive and rebate programs.

- Ensure all information is being captured and shared cohesively.

Key implementing agencies

- Energy Outreach Colorado.
- Energy Services Coalition.
- Heating, ventilation and air conditioning contractors.
- Trade contractors including electricians and mechanical engineers.
- Denver Regional Council of Governments.

DRCOG staff intends to develop a Justice40 Committee, align the rollout of the program with the state, and lead communications and messaging to inform communities of available rebates, multi-lingual shareable marketing resources, lists of vetted contractors, establish a navigator's program to help individuals define their energy needs and more.

Metrics for tracking progress

The following metrics could be used to track success of this strategy:

- Number of rebates and incentives awarded.
- Number of individuals receiving training coordinated through the program, including certifications for contractors from low-income and disadvantaged communities.
- Number of contractors trained with standardized qualifications and included on the equity priority buildings list.
- Number of marketing campaigns and outreach events conducted across the region.
- Cost and type of all-electric technologies, energy bill impacts, and other electrification economic metrics.
- Case studies of successful building electrification projects made publicly available to support information transparency.

Funding sources

Denver Regional Council of Governments

- General funds that may be able to support the initial work on this program prior to full grant funds being received.

Local government contributions

- Memorandum of understanding with local governments.
- Local governments could contribute to the central rebate program and DRCOG could distribute the funds geographically.
- Program funding contributions are scalable based on population size or other metrics.

Supportive Measure No. 2:
Workforce Development

Bring new workers into decarbonization trades and professions and upskilling the current workforce by providing scholarships for industry-provided courses, on-the-job training, and certification. Enable training by providing supportive services such as childcare, transportation to and from training facilities and offsetting lost wages.

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This measure identifies actions state, regional and local government staff and elected officials should take to holistically address existing workforce shortages in the energy efficiency, construction and trades sectors, including:

- Building collaborative networks to connect schools to high-quality job opportunities.
- Providing incentives and scholarships for new or current workforce to learn new skills.
- Supporting energy efficiency and electrification trades.
- Creating hands-on training opportunities to develop a ready-to-deploy workforce.
- Developing a repository of projects that new companies or electrification and efficiency contractors can access.

This measure is critical in ensuring the necessary workforce exists to complete the buildings implementation measures in this plan, both now and in the future. Additional details about the current and future state of the local energy services and electrification trades workforce can be found in the Workforce Development chapter of the plan.

Low-income disadvantaged communities benefits

- Focus outreach on low-income and disadvantaged communities and workers with the opportunity to transition out of the fossil fuel industry.
- Creation of high-quality jobs and workforce development opportunities in disadvantaged communities with an emphasis on expanding opportunity for workers from disadvantaged populations and under-represented small businesses/contractors.
- Supportive services, childcare, transportation, offset wages.

Costs

Training development and incentive costs

DRCOG staff sourced data related to program development, implementation and incentive costs for this strategy from several workforce programs in the U.S. Costs represent the incentives and payments to support trainees in completing the training programs and the total cost to host trainings. The average cost per trainee using existing workforce program data from the states of Colorado and New York show that the cost per person for training and incentives is approximately $3,500.

Total Number of Participants in Training

The total number of trainees expected was based on two categories:

1. Recruitment and training of new workforce to work in the decarbonization field with a focus on low-income and disadvantaged community members.
2. Teaching employees new skills and training them to adapt to new roles (also referred to as upskilling).

For the new workforce category, DRCOG staff used U.S. Census Bureau data to determine the percentage of the Climate Pollution Reduction Grant planning area's population defined as low-income and disadvantaged communities. Staff applied the percentage to the total number of new jobs and determined how many individuals would need fully funded training programs to enter the decarbonization workforce.

For upskilling, DRCOG staff used data from the 2023 Beneficial Electrification Workforce Development Ecosystem study and estimates that by 2035 approximately 3,500 existing heating, ventilation and air conditioning contractors will need to be upskilled to work on heat pump technology.

Costs for the workforce development measure are outlined in Table 4 and reflect high, medium, and low adoption scenarios.

__Table 4.__ Cost to administer a workforce development program for the buildings implementation measures in a high and low adoption scenario. Source: Lotus Sustainability.

Scenario evaluated	Average cost per worker	Total number of new and existing workers trained	Total program costs
High	$3,485	9,440	$8.6 million
Medium	$3,485	4,720	$4.3 million
Low	$3,485	2,360	$2.1 million

Greenhouse gas impacts

Timely action to address workforce shortages by state, regional and local government staff and elected are critical in enabling timely implementation of the buildings implementation measures. However, a calculation of emissions reductions directly associated with workforce development is not feasible.

Co-pollutant impacts

This measure will support buildings implementation of measures, however, it does not have direct, associated co-pollutant reductions.

Implementation timeline and milestones

2024

- Identify funding opportunities and develop strategies to apply for funding and deploy workforce training programs.
- Apply for funding to support programs.

By 2025

- Use workforce studies to identify all relevant implementing agencies and begin coordination on immediate implementation steps.
- Develop tracking mechanisms and launch funding and incentive programs.

2026 to 2030

- Track implementation programs.
- Leverage local and state building performance standards to identify a strong work pipeline for training contractors.

- Review metrics tracked and recalibrate strategy based on the evolving needs of the workforce.
- Identify additional funding sources.
- Track trends and identify additional needs of the workforce.

2030 to 2035

- Continue to implement workforce strategies to train existing and new workforce on electrification and efficiency technologies.

2035

- Train 100% of existing heating, ventilation and air conditioning contractors to install heat pumps.

Key implementing agencies

The following key implementing agencies will be critical to the success of a workforce program:

Government entities

- State government can help coordinate workforce needs between the Climate Pollution Reduction Grant planning area and the rest of the state, with the potential to provide funding for workforce training programs.
- Local governments can create an equity-priority contractor lists, as well as developing a pipeline of projects that newly trained contractors can support.

Trade organizations

- Promote new training opportunities.
- Connect trained contractors to work pipelines.
- Provide group learning opportunities.
- Encourage companies and individuals in their networks to learn more about electrification and efficiency work and technologies.

Trade schools, universities/colleges and high schools

- Ensure there are educational pathways for individuals entering the workforce.
- Upskill or reskill current workers into dependable careers in the electrification industry.

Diversity, equity and inclusion professionals

- Provide culturally relevant support to individuals from diverse backgrounds entering the workforce and workplaces.
- Retain talent and limit turnover in the trades.

Metrics for tracking progress

High quality jobs

- Colorado Department of Labor and Employment program list and employment workforce board updates (include titles, salaries).
- New electrification jobs created (such as people entering the workforce going into heating, ventilation and air conditioning, electrician, installation).
- Number of job fairs and attendees.

Training

- Certifications obtained in green energy implementation.
- Number of people upskilled through trainings, certifications, in electrification technologies and skills.
- Track certification renewals.
- Regional certification that has a recertification process to aid in tracking.

Industry

- Number of electrification general contracting companies or individuals trained to provide electrification services.
- Number of connections made among heating, ventilation and air conditioning and installation contractors.
- Number of new heat pumps installed per certified contractor.
- Number of electrification businesses certified with the Colorado Secretary of State or which have obtained business licenses.
- Number of electrification contractors statewide.

Retention

- Five-year employment pipeline; tracking retention.
- Employment success, such as tenure and performance, compared with number of employees trained.

Outreach

- Amount of engagement.
- How many individuals were reached through marketing campaigns.
- How many individuals participated in programs.

Funding sources

Workforce agencies

- Colorado Department of Labor and Employment's Strengthening Photovoltaic and Renewable Energy Careers program.

Grants

- Environmental Protection Agency community change grants.

Scholarships

- Administered by industry, private foundations, colleges or other universities.

Private sector

- Manufacturers and distributors.
- Telecommunications companies.

Financial institutions

- Banks.
- Credit unions.

Educational institutions

- Community colleges.
- Vocational and technical schools.

Government agencies

- City incentives and regional collaboration funding (address a regional problem together).

Other funds

- City and County of Denver's Climate Protection Fund.
- Huntington National Bank.
- Foundation funds.
- Carl D. Perkins Career and Technical Education Act funding.

Buildings implementation measures

The following four climate pollution reduction measures relate to building decarbonization and energy efficiency. Reducing climate pollution emissions from buildings is pivotal in the collective effort to combat climate change, as buildings represent 52% of the climate pollution in the Planning Area. By enhancing insulation and using all-electric technologies, the strategies in this section have the potential to transform all types and sizes of buildings into environmentally friendly structures.

Buildings implementation measure No. 1:

Commercial, multifamily, municipal, university, school, hospital building electrification and efficiency upgrades

Subsidize and help commercial, multifamily, municipal, university, school, hospital and equity-priority buildings transition from fossil-fuel based systems to electric power.

The program will offer free or discounted services such as energy analyses, heating, ventilation and air conditioning system design, program and rebate guidance, and workforce training. It will also provide funding to install variable refrigerant flow systems, heat pumps, geothermal systems, district heating systems, and other high-efficiency all-electric systems.

program's objective is to pilot new technologies to identify those that can be scaled to support electrification of other commercial buildings.

Low-income and disadvantaged communities benefits

- Prioritization of buildings like schools, multifamily housing and businesses owned by women, Black, Indigenous and people of color in low-income and disadvantaged communities.
- Money savings through efficiency and electrification upgrades.
- Provision of navigation services to implement energy efficient technologies.
- Improved indoor air quality and higher comfort for individuals utilizing these spaces.

Costs

In cost modeling, DRCOG staff used the total square footage in each building category and the cost per square foot for each measure. Staff used square footage data was compiled by county assessor's offices and separated data into the categories of commercial (all types), multifamily (under 50,000 square feet), municipal, college/university, K-12 schools, and hospitals (Table 5).

To determine the cost to electrify existing commercial buildings, staff used data from the City and County of Denver's Energize Denver Renewable Heating and Cooling Plan. The plan included the costs of electrification for space and water heating and the removal and disposal of existing equipment, new system installation, wiring, system controls, electric panel upgrades and new or updated utility service. Data included costs for electrification of cooking equipment and for multifamily building clothes dryer electrification.

Table 5. *Total square footage of building types in the Planning Area and the cost per square foot to electrify. Source: Lotus Sustainability.*

Building type	Square footage total (2025)	Cost per square foot (2025)
Commercial	773,392,432	$8.24
Multifamily (less than 50,000 square feet)	286,636,108	$11.32
Municipal	41,856,814	$12.40
University/college	13,081,975	$12.40
K-12 schools	61,616,286	$12.40
Hospital	14,851,115	$17.11

All costs in Table 5 represent the total upfront cost to electrify the commercial building type. Costs do not include incremental costs, such as incremental costs to convert to an all-electric for new systems versus the cost to install natural gas systems. In practice, there will be a mix of end-of-life replacements and spontaneous replacement of these technologies, and this cost model represents solely the cost of the new technology.

Costs also do not include the operational costs or savings associated with new equipment, once installed.

Greenhouse gas impact

DRCOG staff developed three adoption and participation scenarios to estimate emissions reductions, based on the percent of total square footage to achieve full decarbonization — high (100%), medium (50%), and low (25%) — conveyed in Table 6. Scenarios solely include existing buildings and assume average baseline efficiencies for existing nonelectric equipment (such as, the scenarios do not account for variations in system or equipment types). Electrification includes the following end uses: space heating, water heating, cooking, and clothes drying (multifamily only). Staff estimated fossil fuel consumption by end use based on data from the Commercial Building Energy Consumption Survey from the U.S. Energy Information Administration. Electrification of space heating assumes air source heat pumps are installed, using cold climate heat pumps.

Table 6. *Greenhouse gas emissions impacts by scenario with total building square footage included in each scenario. Source: Lotus Sustainability.*

Scenario	Total square feet in scenario (2050)	Cumulative greenhouse gas reductions 2025-2050 (metric tons)	Annual greenhouse gas reductions in 2050 (metric tons)
High	1,196,812,424	26,774,197	2,055,258
Medium	601,095,059	14,595,930	1,115,313
Low	303,236,377	7,727,960	585,213

Co-pollutant Impacts

Table 7 details the predicted reduction of co-pollutant emissions from this strategy. The co-pollutants represent criteria air pollutants defined by the U.S. Environmental Protection Agency and provide additional context into the health and equity impacts of greenhouse gas emission sources. High levels of criteria air pollutants can lead to negative health effects including respiratory disease and are determined based on point-in-time measurements of pollutants that exceed standards.

Emissions from electricity are assumed to rise and fall at the same rate as carbon dioxide emissions, based on the regional emissions factors. The percent change in carbon dioxide emissions factor is used as a proxy for co-pollutants from electricity. Natural gas, diesel fuel, and propane use direct calculations from the U.S. Environmental Protection Agency's AP-42: Compilation of Air Emissions Factors from Stationary Sources.

Table 7. *Cumulative co-pollutant reductions in metric tons by 2050 by scenario and co-pollutant. Source: Lotus Sustainability.*

Implementation rate	Nitrogen Oxides	Carbon Dioxide	Particulate Matter	Sulfur Dioxide	Volatile Organic Compounds
High	29,950	21,264	2,138	2,774	1,392
Medium	16,151	11,467	1,153	1,496	751
Low	8,370	5,943	598	775	389

Implementation timeline and milestones

When considering the implementation timeline and milestones for this measure, utility forecasting and the current and near future state of electric grid infrastructure must be accounted for to ensure electrification is driving down carbon emissions in the near term. In addition, it is important to consider the State of Colorado and local government codes and policies that will influence the adoption of all-electric technologies and may require building owners to make upgrades for efficiency and electrification. Finally, stakeholders recommend the exploration of new technologies for all-electric space and water heating and accounting for them in the timeline as they become available in Colorado. Overall, this strategy should be implemented using a phased approach based on existing and emerging technologies.

Timeline

2024-2028

- Use state and federal grant funding to pilot electrification projects including geothermal loops, ambient loops and district heating systems.
- Identify successful projects for replication in the Denver region.

2028-2035

- Identify funding sources.
- Pinpoint projects in the Denver region to foster and scale commercial building electrification.

Key implementing agencies

Public sector

- Municipalities and their permitting departments.
- Colorado Weatherization Assistance Program administrators.
- Housing authorities.

Utilities

- Investor-owned utilities.
- Municipal utilities.
- Cooperatives.
- Colorado Public Utilities Commission.

Workforce agencies

- Trade unions, community colleges and other technical trade education entities.

Private sector

- Contractors for infrastructure upgrades and equipment.
- Insurance agencies.
- Heating, ventilation, and air conditioning installers.

Funding sources

There are three types of funding available for commercial and multifamily buildings:

Federal funding sources

- U.S. Department of Housing and Urban Development grants.
- Inflation Reduction Act tax credits.
- Microgrid and essential infrastructure funding.

State agency funding sources

- State-level rebates.
- Commercial property-assessed clean energy loans.
- Microgrid and essential infrastructure funding.
- State of Colorado geothermal energy grant program.

Local funding sources

- City-specific rebates (examples include City and County of Denver and the City of Boulder).
- Utility rebates.
- Colorado Clean Energy Fund to finance low-interest loans.
- Chamber of Commerce.

Projects completed

- Total number of heat pumps installed.

- Recommendations assessed versus. implemented.
- Number of buildings serviced in equity priority areas.
- Equity concerns — robust tracking of who is being served (multifamily units prioritized).

Energy use

- Energy saved (kilowatt-hours/therms).
- Greenhouse gas emissions reductions.

Cost

- Utility cost impacts: What are the cost implications for end users, specifically low-income disadvantaged community members.

Co-benefits

- Quantification of co-benefits: Indoor air quality impacts and health impacts of adding electric equipment to cool units versus gas equipment.

Buildings implementation measure No. 2:
Multifamily property owners building decarbonization

Support existing, large multifamily property owners in decreasing costs and climate pollution emissions through energy efficient and electrification upgrades.

In August 2023, the Colorado Air Quality Control Commission approved the Building Performance Standards Rule which applies to commercial, multifamily and public buildings 50,000 square feet or larger. The rule mandates property owners report their energy usage annually to the State of Colorado. Building owners must meet the required greenhouse gas reduction targets for 2026 (7% reduction) and 2030 (20% reduction).

A centralized agency should create a voluntary incentive program for multifamily property owners to accelerate building decarbonization projects, ensure affordability of rental rates, and support local affordable housing plans and policies. The program provides technical and funding support (including training for facilities managers and staff) for energy efficiency, renewable energy systems, and electrification improvements across multifamily portfolios, and uses contractors from an equity priority list when feasible. The program will identify buildings required to make efficiency upgrades

through local or state building performance standards and buildings with restrictions in place to ensure long-term affordability in rental rates for tenants.

This measure supports owners of existing multifamily affordable housing properties and other equity-priority commercial buildings greater than 50,000 square feet in making energy efficient and electrification upgrades to their buildings to achieve compliance with the State's Building Performance Standards. Equity-priority buildings serve frontline communities (groups that face the effects of climate change at higher rates than those with more resources) with less access to resources and who may face more barriers adapting to a changing climate.

Low-income and disadvantaged communities benefits

Prioritization of contractors from an equity priority list:

- Black, Indigenous, and other people of color.
- Woman owned.
- Small, local contractors.
- Ensure affordability for renters.
- Location of multifamily in Justice40.
- Continuous engagement with emphasis on multicultural, multilingual, and more.
- Improved interior air quality in homes due to elimination of natural gas appliances.

Costs

DRCOG staff determined costs using a cost per square foot metric for electrification of the building types covered in this strategy. Staff compiled building square footage using data provided by county assessors offices.

Staff based upgrade costs were on data from the City and County of Denver's Energize Denver Renewable Heating and Cooling Plan. The cost analysis from Denver's plan included costs of electrification for space and water heating, including the removal and disposal of existing equipment, new system installation, wiring, system controls, electric panel upgrades and new/updated utility service. It assumed each unit has a range or cooktop and a clothes dryer to be replaced.

A breakout of proposed government incentive and project costs are conveyed in Table 8. Government incentives included in this scenario represent an amount equal to 10% of the project cost. Multifamily buildings are already required to improve their efficiency via Colorado's Building Performance Standards and affected building owners must continue to report how much energy they use annually to the Colorado Energy Office. Owners of buildings that do not already meet standards need to find ways to reduce how much energy they use or make changes to the energy sources to help meet the statutory greenhouse gas reduction targets for 2026 and 2030 — one pathway to achieve compliance is through building electrification.

According to the City and County of Denver's Energize Denver Renewable Heating and Cooling Plan, large multifamily buildings were assumed to be an average of Denver's Energize Denver Renewable 84,630 square feet.

Table 8. *Government incentives and remaining project costs by scenario with total building square footage included in each scenario. Source: Lotus Sustainability.*

Implementation rate	Total cost of government incentives	Total private project costs
High	$3.42 billion	$30.8 billion
Medium	$1.71 billion	$15.4 billion
Low	$0.86 billion	$7.7 billion

Greenhouse gas impact

DRCOG staff developed three adoption and participation scenarios to estimate emissions reductions according to participation rate. Staff modeled a high (100%), medium (50%), and low (25%) scenario and adjusted the amount of square footage affected by this strategy, as detailed in Table 9. To determine the annual and cumulative greenhouse gas impact of this large multifamily building strategy, the model assumes that all buildings required to meet Colorado's Building Performance Standards will achieve necessary reductions. Staff modeled emissions using the emission intensity pathway for Building Performance Standards compliance as described in the Colorado Energy Office's Building Performance Standards Draft Technical Resource Guide. Staff used the Building Performance Standards multifamily targets for this strategy.

The model assumes a linear reduction in greenhouse gas emissions for all multifamily buildings through 2030 incorporating known and mandated utility emissions reductions. It then holds greenhouse gas emissions constant from 2030 through 2050.

Table 9. *Greenhouse gas emissions impacts by scenario with total building square footage included in each scenario. Source: Lotus Sustainability.*

Implementation rate	Square feet in scenario (2050)	Cumulative greenhouse gas reductions 2025-2050 (metric tons)	Greenhouse gas reductions in 2050 (metric tons)
High	140,016,623	9,179,619	308,971
Medium	70,008,312	4,589,810	154,485
Low	35,004,156	2,294,905	77,243

Co-pollutant impacts

Table 10 depicts the predicted reduction of co-pollutants as a result of the implemented strategies. Staff included criteria air pollutants, which can provide additional context into the health and equity impacts of greenhouse gas emission sources, with high levels leading to negative health effects, such as respiratory disease. The values presented in

Table 10 does not represent a complete inventory of criteria air pollutant emissions within the region and only reflect criteria air pollutant emissions produced from greenhouse gas emission sources. Negative health effects from criteria air pollutants cannot be directly determined from a cumulative inventory and potential health impacts are determined based on point-in-time measurements of pollutants and exceedance of standards. However, quantifying cumulative pollutant emissions can help identify sources that may lead to standard exceedances.

For this approach, DRCOG staff assumed emissions from electricity rise and fall at the same rate as carbon dioxide emissions, based on the regional emissions factor. Staff used the percent change in carbon dioxide emissions factor as a proxy for co-pollutants from electricity. Analysts used natural gas, diesel and propane as direct calculations using the U.S. Environmental Protection Agency's AP-42: Compilation of Air Emissions Factors from Stationary Sources.

Table 10. *Cumulative co-pollutant reductions in metric tons by 2050 by scenario and co-pollutant. Source: Lotus Sustainability.*

Implementation rate	Nitrogen Oxides	Carbon Dioxide	Particulate Matter	Sulfur Dioxide	Volatile Organic Compounds
High	5,330	2,908	349	1,078	190
Medium	2,665	1,454	175	539	95
Low	1,333	727	87	269	48

Implementation timeline and milestones

Some key considerations when developing a timeline and milestones include:

- Utility forecasting and the current and near-future state of the electric grid infrastructure.
- Denver's building performance standards timeline.

Other considerations when considering timelines include:

- Aligning with code adoption cycles.
- Incorporating time for enforcement and compliance.
- Creating a phased approach based on existing and emerging technologies.
- At the beginning of the program, incorporating time to hire new staff for administration of programs.

Timeline:
2024-2025

- Identify low-income and disadvantaged communities and equity-priority buildings needing support to earn Building Performance Standard compliance throughout Colorado.
- Leverage the state's resources to develop a cohort of buildings in the region to support building upgrades.
- The cohort will share information, best practices and successes for upgrades.

2025-2030

- Building on the success of the first cohort, identify additional equity-priority and low-income and disadvantaged communities' buildings that need support.
- Ensure building upgrade financial and resource support is provided so that buildings can meet Building Performance Standard requirements in 2030.

Key Implementing agencies

Public sector

- Municipalities and permitting departments.
- Colorado Weatherization Assistance Program administrators.
- Housing authorities.

Utilities

- Investor-owned utilities.
- Municipal utilities.
- Cooperatives.
- Colorado Public Utilities Commission.

Workforce agencies

- Trade unions (to help expand the workforce).

Private sector

- Contractors for infrastructure upgrades and equipment.
- Insurance agencies, because they are lowering rates for all-electric buildings and units.
- Heating, ventilation and air conditioning installers.

Other entities

- Navigators to help monitor energy tracking.

Funding sources

There are three key funding areas:

Federal funding sources

- U.S. Department of Housing and Urban Development grants.
- Tax credits from the Inflation Reduction Act.
- Microgrid/essential infrastructure funding.

State agency funding sources

- Colorado Clean Energy Fund to finance low interest loans.
- Commercial property-assessed clean energy loans.
- Microgrid and essential infrastructure funding.
- State of Colorado geothermal energy grant program.

Local level funding sources

- City-specific rebates (examples include the City and County of Denver and the City of Boulder).
- Utility rebates.
- Chambers of Commerce to find housing resiliency for workforce incentives.

Metrics for tracking progress

Projects completed

- Total number of heat pumps installed.
- Recommendations assessed versus implemented.
- Number of buildings serviced in equity priority areas.
- Equity concerns— robust tracking of who is being served (multifamily units especially).

Energy use

- Energy saved (kilowatt-hours/therms).
- Greenhouse gas emissions reductions.

Cost

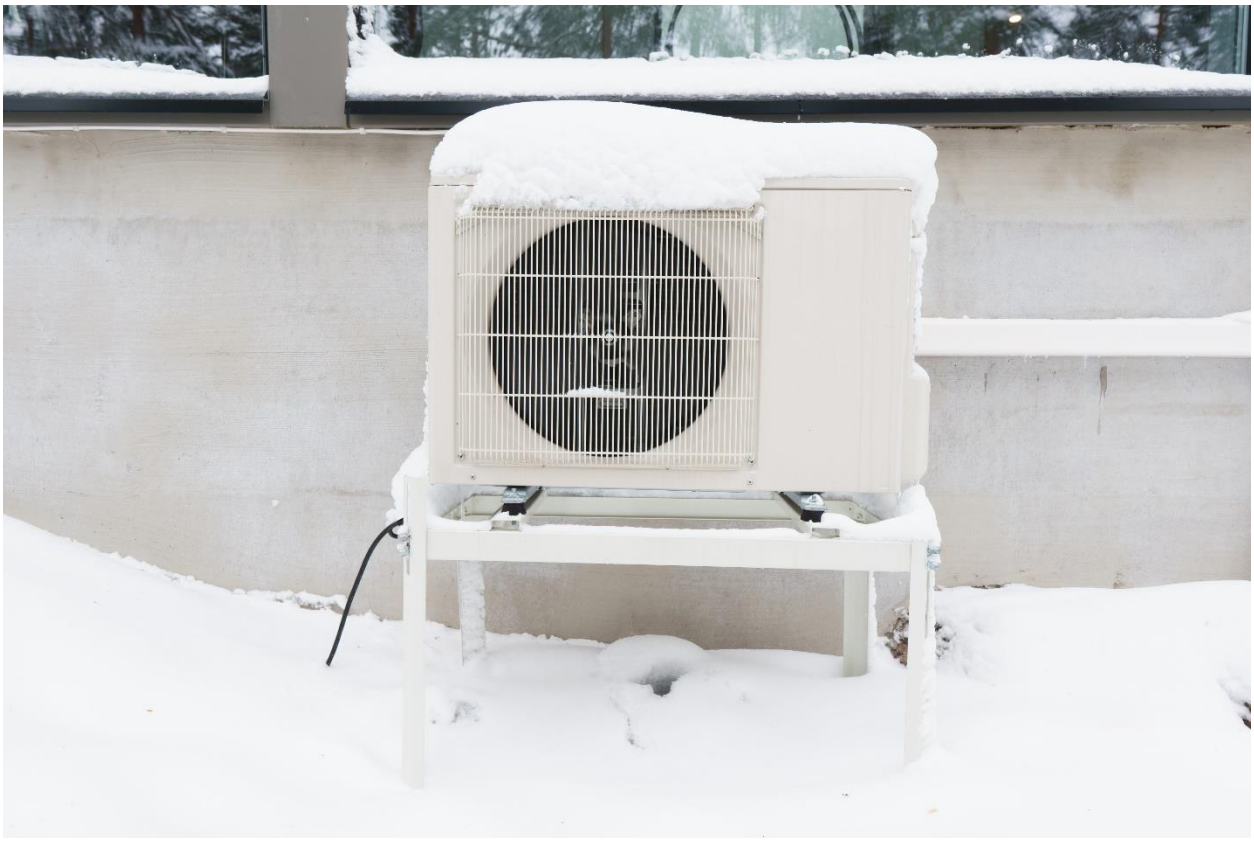
- Utility cost impacts.
- Equity — what are the cost implications for end users?

Quantification of co-benefits

- Indoor air quality impacts.
- Impact of adding cooling to units.
- Health risks of gas equipment versus electric equipment.

Buildings implementation measure No. 3:
Residential building electrification and energy audits

Help the region's residents upgrade and decarbonize their homes with as little hassle and cost as possible, prioritizing the most vulnerable residents.



Implement a program to electrify homes across the region, working in partnership with trusted community-based organizations. The program will offer free services to low-income, disproportionately affected households. Energy audit services include energy, electrification and health audits; upgrade funding; and training and support for residents and community-based organizations on engaging with landlords; and health and energy use in residents' owned or rented homes. As the program expands, its managers would add workers and monitor analytics surrounding program implementation and growth. Ideally, this measure would be run through and managed by a central administration.

Low-income and disadvantaged communities benefits

- Free services to low-income, disproportionately affected households.
- Recognizing outreach to low-income disadvantaged communities concern around pollution, improvement of at-home air quality with replacement of gas appliances.

- Support home renters and owners to improve energy efficiency and electrify their homes and decrease energy costs.

Cost

DRCOG staff analyzed several data sources to estimate the cost of implementing this measure. Staff used costs per square foot for electrification and average square footage per household from an analysis completed for the City and County of Denver's Energize Denver Renewable Heating and Cooling Plan that estimated electrification costs for a variety of building types, systems and replacement technology combinations. Also, cost per square foot is provided for each stage of electrification: old system removal, new system installation, wiring, controls, and panel or utility service upgrades. Staff collected electric equipment cost forecasts from the National Renewable Energy Laboratory Electrification Futures Studies moderate advancement scenario. The research authors assumed that technological advancement and rapid increase will lead to moderate cost reductions for heat pumps and heat pump water heaters through 2050. However, analysts assumed removal and disposal of existing equipment, local wiring, system controls, panelboard upgrades, new and upgraded utility service, range and stove cooktop stay constant. According to the cost modeling depicted in Table 11, the average cost per household to implement this measure is $33,075.

Table 11. *Total cost of government incentives and remaining project costs for buildings measure No. 3 under the implementation scenarios. Source: Lotus Sustainability.*

Implementation rate	Total cost of government incentives	Total remaining project costs
High	$9.13 billion	$11.57 billion
Medium	$4.56 billion	$5.79 billion
Low	$2.28 billion	$2.89 billion

Greenhouse gas impact

DRCOG staff developed three adoption and participation scenarios to estimate emissions reductions according to participation rate. DRCOG staff modeled a high (100%), medium (50%), and low (25%) scenario. These scenarios, as highlighted in Table 12, adjust the number of households affected by this measure and only targets existing single-family homes in the Climate Pollution Reduction Grant Planning Area. DRCOG staff estimated the total number of single-family homes within the planning area based on total number of households that are detached or attached as defined by the U.S. Census Bureau. Another assumption is to target all primary residential natural gas and propane uses in space heating, water heating, cooking, and clothes drying (impacts from space cooling due to electrification are also accounted for). Also, it is acknowledged that not all homes use fossil fuels for each end use (for example, some homes use electric resistance for heating instead of natural gas furnaces).

DRCOG staff estimated the number of homes using each fossil fuel end use using data from the U.S. Energy Information Administration's Residential Energy Consumption

Survey, establishing baseline energy use prior to electrification. Analysts estimated additional electricity consumption from electrification by comparing the original equipment's efficiency to that of the upgraded equipment. DRCOG used data for forecast efficiencies for space heating and water heating through 2050 from the National Renewable Energy Laboratory (cooking and clothes drying upgraded equipment efficiencies are held constant over time). Under the proposed measure, in 2050, an estimated 752,628,529 therms of natural gas and an estimated 1,975,817 gallons of propane will be avoided (Table 12).

Table 12. *Greenhouse gas emissions impact by scenario, factoring in total building square footage. Source: Lotus Sustainability.*

Implementation rate	Households in scenario (2050)	Cumulative greenhouse gas reductions 2025-2050 (metric tons)	Greenhouse gas reductions in 2050 (metric tons)
High	910,412	48,223,313	3,717,304
Medium	455,206	24,111,657	1,858,652
Low	227,603	12,055,828	929,326

Co-pollutant impacts

Table 13 details the predicted reduction of co-pollutants resulting from the implemented measure. Staff included criteria air pollutants are to provide additional context into the health and equity effects of greenhouse gas emission sources. The values presented do not represent a complete inventory of criteria air pollutant emissions within the region and only reflect criteria air pollutant emissions produced from greenhouse gas emission sources. High levels of criteria air pollutants can lead to negative health impacts including respiratory disease (it's important to note this cannot be directly determined from a cumulative inventory as is reported here). Potential health impacts are determined based on point-in-time measurements of pollutants and exceedance of standards set by the U.S. Environmental Protection Agency.

For this approach, staff assumed emissions from electricity will rise and fall at the same rate as carbon dioxide emissions, based on the regional emissions factor. DRCOG staff used the percent change in carbon dioxide emissions factor as a proxy for co-pollutants from electricity. Staff used direct calculations of natural gas, diesel and propane from the U.S. Environmental Protection Agency's AP-42: Compilation of Air Emissions Factors from Stationary Sources.

Co-pollutants for this measure indicate a slight increase in sulfur dioxide emissions due to additional electricity consumption. Because the region is served by multiple utilities, utilities that maintain fossil fuel generation will contribute to the additional sulfur dioxide emissions.

Table 13. Cumulative co-pollutant reductions in metric tons by 2050 by scenario and co-pollutant. Source: Lotus Sustainability.

Implementation rate	Nitrogen Oxides	Carbon Dioxide	Particulate Matter	Sulfur Dioxide	Volatile Organic Compounds
High	37,176	37,387	3,049	-3,826	2,442
Average	18,588	18,694	1,524	-1,913	1,221
Low	9,294	9,347	762	-957	611

Implementation timeline and milestones

When considering the timeline for rollout of this residential strategy, the program will align with the Inflation Reduction Act funding, updates to the International Energy Conservation Code and updates to local codes.

By 2025

- Establish centralized coordinating agency.
- Identify verified contractor list and regional qualifications.

2025-2030

- Launch the program, track metrics and share successes.
- Track low-income and disadvantaged community households served by the program.
- Recalibrate the program if the minimum threshold for participation has not been attained.

By 2030 or 2035

- Adapt program as needed to align with local codes and policies.

Key Implementing Agencies

Utilities

- All utilities in the Climate Pollution Reduction Grant Planning Area.

Nonprofits

- Energy Outreach Colorado.
- Colorado Clean Energy Fund.
- Rocky Mountain Conservancy Conservation Corps.

- Mile High Youth Corps.

Government agencies

- Colorado energy office.
- Public health agencies.
- U.S. Department of Energy funding through the Buildings Upgrade Prize.
- Local governments, to adopt universal codes and standards to require electrification infrastructure.

Community organizations

- Neighborhood organizations and community leaders.

Private sector

- Home repair contractors and organizations.

Regional Planning

- Denver Regional Council of Governments.

Income qualifications

- Sister Carmen Community Center.
- Departments of human services.
- Local food pantries could assist with promotion and outreach to low-income and marginalized communities.

Funding sources

- Federal, state and local government agencies can serve as primary funding sources to implement residential strategy programs.
- Green bank loans, which are subsidized loans at below-market interest rates administered through the U.S. Environmental Protection Agency.
- The Internal Revenue Service's direct pay feature may be used when the program receives federal funding. Local governments can supplement external funding with matching funds.
- Utilities are a key funding source and increasing residents access to low-income community solar gardens can help offset utility costs.

Metrics for tracking progress

Social Media

- Use social media to reach various and diverse audiences and to track the number of individuals reached.

Costs

- Track effects on utility bills and the average cost to install heat pumps or other electrification technologies.

Quantitative

- Quantitative metrics include greenhouse gas emissions reductions, effects on electric loads, number of enrollees in the program, total gas usage reduction, and the number of homes that use less gas than a home that has gas appliances.

Other considerations

- Key metrics will be tracked including indoor air quality, average household income of enrollees, and fossil gas consumption per capita.
- Anti-displacement metrics will be collected using qualitative surveys asking about increases in housing costs.

Buildings implementation measure No. 4:

Free home weatherization and energy efficiency services for low-income disadvantaged communities

Provide free weatherization and energy efficiency improvements to low-income and disadvantaged community members, while providing discounts and advice to assist all residents.

Stakeholders and DRCOG staff will collaborate with Colorado Clean Energy Fund, Energy Outreach Colorado, and existing energy efficiency and weatherization programs in the state of Colorado to serve the full Climate Pollution Reduction Grant Planning Area in offering free energy efficiency and pre-electrification upgrades. Regardless of their homeownership or renter status, services will be provided to households at or below 80% of the area median income and low-interest loans provided to households between 80% and 120% of the area median income. Area median income is the midpoint of a specific area's income distribution and is calculated annually by the U.S. Department of Housing and Urban Development. Ideally, services would include additional financial support for all participants to address code compliance issues arising during home upgrades and anti-displacement requirements.

Additionally, this measure would buy down the interest rate on energy efficiency loans provided by the Colorado Clean Energy Fund for individuals between 80% and 120% of the area median income.

Low-income disadvantaged communities benefits

- Target low-income disadvantaged communities that own or rent.
- Provide services specifically for households at or below 80% of the area median income.
- Offer low-interest loans for households between 80% and 120% of the area median income.
- Reduction in utility costs.
- Increase home comfort through stable interior temperatures.

Cost

Pre-electrification is assumed to include panelboard upgrades and new or upgraded utility service. DRCOG staff used costs per square foot for electrification and average square footage per household from an analysis completed for the City and County of Denver's Energize Denver Renewable Heating and Cooling Plan that estimated electrification costs for a variety of building types, systems, and replacement technology combinations. Costs per square foot are provided for each stage of electrification: old system removal, new system installation, wiring, controls, and panel or utility service upgrades.

Staff converted costs per kilowatt-hour saved from 2016 dollars to 2023 dollars. Costs per therm saved were converted from 2017 dollars to 2023 dollars.

Staff assumed interest rates will stay constant and are based on an average 120-month loan with a FICO score under 600. Interest buydown assumes all the difference between the market rate interest and buy down interest rate is paid upfront in the year of the project or loan.

The loan loss reserve assumes 10% of the loan is placed in the reserve. The reserve does not represent a cost as the funds are retained unless a loan is unpaid. Analysts used a 5% estimated first loss rate while modeling cost scenarios.

Table 14. *Total cost of government incentives and remaining project costs for households below 80% of the area median income under the implementation scenarios. Source: Lotus Sustainability.*

Implementation rate	Total cost of government incentives
High	$2.05 billion
Medium	$1.02 billion
Low	$0.51 billion

Table 15. Total cost of government incentives and remaining project costs with interest rate buydown for households between 80% and 120% of the area median income under the implementation scenarios. Source: Lotus Sustainability.

Implementation rate	Total cost of government incentives
High	$616.4 million
Medium	$308.2 million
Low	$154.1 million

Table 16. Total cost of government incentives and remaining project costs for loan loss reserve for households between 80% and 120% of the area median income under the implementation scenarios. Source: Lotus Sustainability.

Implementation rate	Total cost of government incentives
High	$59.8 million
Medium	$29.9 million
Low	$15.0 million

Greenhouse gas impact

DRCOG staff developed three adoption or participation scenarios to estimate emissions reductions according to participation rate. Staff modeled a high (100%), medium (50%), and low (25%) scenario. Each scenario depicted in Table 17 adjusts the number of households affected by this measure. Scenarios target only existing homes and provide funding for energy efficiency and pre-electrification work on homes under 80% of the area median income and between 80% and 120% of the area median income. Analysts assumed pre-electrification has no direct greenhouse gas effects and account for effects from subsequent full electrification in the single-family home electrification strategy.

Staff used the number of households that fall within the eligible area median income thresholds from the U.S. Department of Housing and Urban Development Consolidated Planning/Comprehensive Housing Affordability Strategy database. Staff used the database for the total number of households within each county in the DRCOG Climate Pollution Reduction Grant Planning Area and the number of households within each income threshold. Staff used the share of homes within each income category to estimate the number of single-family homes within each threshold.

DRCOG staff estimated energy use by fuel type based on energy use per household for all single-family homes. Staff estimated energy savings from efficiency based on a study conducted by the National Renewable Energy Laboratory on the total potential energy savings from cost-effective improvements. The laboratory's study included energy savings from electrification and estimated total savings possible from all strategies

except for electrification. Staff used the resulting value to estimate the percent reduction in energy use from each participating household and total energy savings based on the share of potential savings that could be achieved from each fuel type. For example, lighting upgrades will only impact electricity use, so energy savings are not expected to be the same for each fuel type.

The result is an estimated reduction of 55,881,647 therms of natural gas, an estimated 146,702 gallons of propane, and an estimated 611,935,841 kilowatt-hours of electricity.

Table 17. *Greenhouse gas emissions impacts by scenario with total building square footage included in each scenario. Source: Lotus Sustainability.*

Implementation Rate	Households in scenario (2050)	Cumulative Greenhouse gas reductions 2025-2050 (metric tons)	Greenhouse gas reductions in 2050 (metric tons)
High	496,820	5,776,653	424,501
Medium	248,410	2,888,327	212,251
Low	124,205	1,444,163	106,125

Co-pollutant Impacts

Table 18 details the predicted reduction of co-pollutants from implemented strategies. Staff included criteria air pollutants to provide additional context into the health and equity impacts of greenhouse gas emission sources. Staff intended such data to be used as supplemental information to the greenhouse gas inventory results and to highlight the effects of the sources included in this inventory beyond greenhouse gas emissions. The values presented in Table 18 do not represent a complete inventory of criteria air pollutant emissions within the region. Such data only reflects criteria air pollutant emissions also produced from greenhouse gas emission sources. High levels of criteria air pollutants can lead to negative health effects including respiratory disease. Negative health effects from criteria air pollutants cannot be directly determined from a cumulative inventory. Staff determined potential health effects based on point-in-time measurements of pollutants and exceedance of standards set by the U.S. Environmental Protection Agency. However, quantifying cumulative pollutant emissions can help identify sources that may lead to standard exceedances.

For this approach, staff assumed emissions from electricity to rise and fall at the same rate as carbon dioxide emissions, based on the regional emissions factor. DRCOG staff used the percent change in carbon dioxide emissions factor as a proxy for co-pollutants from electricity. Staff used direct calculations for natural gas, diesel and propane from the U.S. Environmental Protection Agency's AP-42: Compilation of Air Emissions Factors from Stationary Sources.

Table 18. *Cumulative co-pollutant reductions in metric tons by 2050 by scenario and co-pollutant. Source: Lotus Sustainability.*

Implementation rate	Nitrogen Oxides	Carbon Dioxide	Particulate Matter	Sulfur Dioxide	Volatile Organic Compounds
High	4,063	2,711	284	496	177
Average	2,031	1,355	142	248	89
Low	1,016	678	71	124	44

Implementation timeline and milestones

When considering the timeline for rollout of the residential strategies, DRCOG staff recommends that the program with the Inflation Reduction Act funding availability, updates to the International Energy Conservation Code and updates to local codes.

2024

- Identify funding sources to expand the reach of Energy Outreach Colorado and to buy down interest rates from the Colorado Clean Energy Fund.

2025-2030

- Deploy funding to coordinate messaging and outreach on available programs and low-interest rates available to the residents of the Climate Pollution Reduction Grant Planning Area.
- Track low-income and disadvantaged communities' participation.

Key implementing agencies

The key implementing agencies for the residential strategies potentially include the following:

Utilities

- All utilities in the Climate Pollution Reduction Grant Planning Area.

Nonprofits

- Energy Outreach Colorado.
- Colorado Clean Energy Fund.
- Rocky Mountain Conservancy Conservation Corps.
- Mile High Youth Corps.

Government agencies

- Colorado Energy Office.
- Public health agencies.
- U.S. Department of Energy.
- Local governments.

Community organizations

- Neighborhood organizations and community leaders.

Private sector

- Home repair contractors and organizations.

Regional planning

- Denver Regional Council of Governments.

Income qualifications

- Sister Carmen Community Center.
- Departments of human services.
- Local food pantries.

Funding sources

- Federal, state, and local government agencies can serve as primary funding sources to implement residential strategy programs.
- Green bank loans, subsidized loans at below-market interest rates administered through the U.S. Environmental Protection Agency.
- Use the Internal Revenue Service's direct pay feature when regional or local governments receive federal funding.
- Local governments can supplement external funding with matching funds.
- Utilities.

Metrics for tracking progress

The following metrics were identified to evaluate the impacts of the residential strategies:

Social media

- Use social media to reach various and diverse audiences and to track the number of individuals reached.

Costs

- Track effects on utility bills and the average cost to install heat pumps or other electrification technologies.

Quantitative

- Track quantitative metrics including greenhouse gas emissions reductions, effects on electric loads, number of enrollees in the program, total gas usage reduction, and the number of homes that use less gas than a home that has gas heating and water heating.
- Track additional electric appliance installations that aren't enrolled in the program.

Other considerations

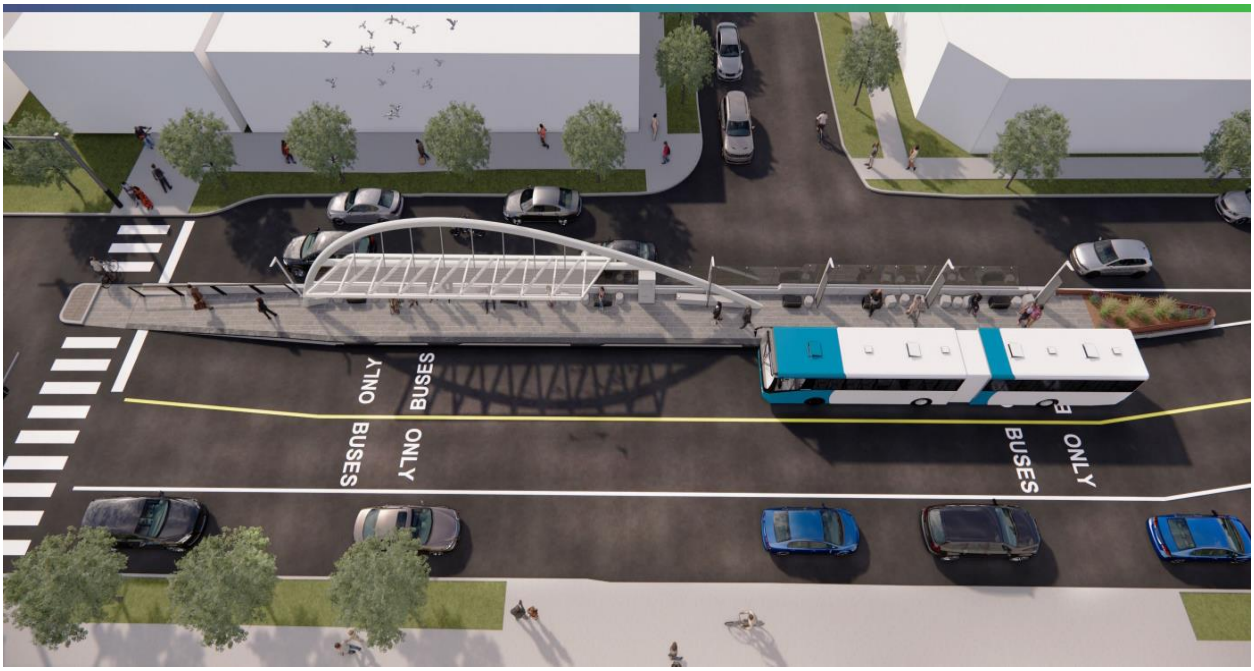
- Track key metrics including indoor air quality, average enrollee household income, and fossil gas consumption per capita.
- Track anti-displacement metrics using qualitative surveys asking about increases in housing costs.

Transportation implementation measures

Transportation is an essential aspect of contemporary life, but it also contributes significantly to climate pollution, making up 34% of the Denver area's emissions. While the Comprehensive Climate Action Plan will explore many additional transportation measures, two strategies were identified as priorities for reducing climate pollution through DRCOG's planning efforts. The measures will lower greenhouse gas emissions by reducing vehicle miles traveled, while promoting safe, reliable modes of transportation.

Transportation implementation measure No. 1:
Regional bus rapid transit expansion

Complete an ambitious expansion of a regional bus rapid transit network by 2030, providing reliable, fast public transportation options, decreasing usage of single-occupant vehicles and vehicle miles travelled.



Source: Regional Transportation District

Stakeholders and DRCOG staff will coordinate with regional transportation agencies including, but not limited to, the Colorado Department of Transportation, Denver Regional Council of Governments, Regional Transportation District, and local jurisdiction planning departments to develop a regional bus rapid transit network that better serves low-income and disadvantaged communities while supporting regional transit connectivity. This strategy will use framework established by the cooperating agencies, and will prioritize the development of the following corridors by 2030:

- East Colfax Bus Rapid Transit: Colfax Avenue from Union Station to Interstate 225.
- East Colfax Bus Rapid Transit Extension: Colfax Avenue from Interstate 225 to Interstate 70.
- State Highway 119 Bus Rapid Transit: Downtown Boulder to Longmont (Ute Highway).
- Federal Boulevard Bus Rapid Transit: Federal Boulevard from Dartmouth Avenue to 120th Avenue.
- Colorado Boulevard Bus Rapid Transit: Colorado Boulevard from Interstate 25 to Interstate 70.

Low-income and disadvantaged communities benefits

- Improved transit performance and reliability from improved boarding efficiency and dedicated transit right-of-way along corridors serving marginalized communities.
- Additional dedicated transit infrastructure sets the stage for improved service frequency along corridors serving marginalized communities.
- Increases in transit infrastructure are correlated to increased ridership – additional ridership results in an improvement in air quality.
- A reliable travel option equates to reliability on being on time.
- Supports a transportation option that benefits households without a vehicle, avoids congestion and improves both health and air quality.
- Free youth fare.

Cost

To model costs for this measure, DRCOG staff relied heavily on estimates previously provided for five bus rapid transit expansion projects. Staff incorporated previous estimates into the model as upfront costs in 2025, though those costs are likely to be spread out over many years. Based on individual project scope, staff used total miles added to the network (route miles multiplied by the number of scheduled trips) to develop the upfront cost. Staff estimated ongoing maintenance costs using transit agency or federal studies.

Table 19. *Total bus rapid transit miles added, with upfront and ongoing costs per mile and cumulative from 2025-2050. Source: Lotus Sustainability.*

Strategy	Bus rapid transit route miles added	Upfront costs per mile	Ongoing costs per mile	Upfront costs (2025)	Ongoing costs cumulative (2026-2050)
Bus rapid transit expansion	6,729,632	$115	$1.64	$763 million	$290 million

Greenhouse gas impact

This measure includes the conversion of several existing transit routes into bus rapid transit routes. DRCOG staff provided total one-way miles and te expected frequency of each route for the analysis. Using the frequency and one-way distance, staff estimated the total annual miles driven along all bus rapid transit routes. Staff did not directly calculate emissions from mileage, rather, they based emissions on the Colorado Department of Transportation Greenhouse Gas Mitigation Measures Policy Directive which includes avoided metric tons of carbon dioxide equivalent per mile of bus rapid transit driven during various timeframes. Staff applied resulting values to the estimated bus rapid transit mileage to estimate total avoided greenhouse gas emissions. Colorado Department of Transportation Policy Directive estimates are based on a high electric vehicle adoption scenario. Emission reductions for years closer to 2050 may vary from those included in the directive if electric vehicle adoption does not meet projected scenarios.

Table 20. *Cumulative greenhouse gas emissions reductions developing the bus rapid transit network. Source: Lotus Sustainability.*

Strategy	Cumulative greenhouse gas reductions 2025-2050 (metric tons)
Develop a bus rapid transit network	1,518,654

Co-pollutant impacts

Increases in transit infrastructure are correlated with increased ridership – additional ridership is correlated with a reduction in particulate matter and ozone precursor emissions. Ozone precursors include volatile organic compounds and nitrogen oxides. As specific ridership estimates were unavailable for the development of the plan, DRCOG staff were unable to calculate specific estimates of co-pollutant reductions.

Implementation timeline and milestones

DRCOG staff are currently working with jurisdictions in the region to identify priorities, set goals and aggressive timelines to achieve bus rapid transit objectives. The first five bus rapid transit corridors outlined in this strategy are set to be completed by 2030.

Key implementing agencies

The key implementing agencies for the transportation and mobility strategies should include the following:

Government organizations

- Local governments adopt zoning incentives or requirements for active transportation such as sidewalk repair, bus stop improvements, bike storage and parking reductions.
- Colorado Department of Transportation.
- The Regional Transportation District is working on a technology program to help older adults and people who don't speak English as a first language navigate transit applications more easily.
- Denver Regional Council of Governments.

Community organizations and commissions

- Commerce City Transportation Commission.
- Commerce City Environmental Policy Advisory Committee.
- Denver Streets Partnership.
- Local advocacy organizations.

Housing organizations

- The Colorado Housing Finance Authority works with developers to ensure communities aren't displaced as infrastructure improvements and connectivity improvements occur, and ensures affordable housing is built around transit centers.

Metrics for tracking progress

- Miles of bus rapid transit route developed.
- Ridership.
- Transit on time performance.
- Housing density and affordability adjacent to bus rapid transit stops.
- Vehicle miles traveled.

Other considerations for tracking include the use of the Denver Regional Council of Government's Way to Go program, which promotes transportation options and employer incentives for promoting non-drive-alone trips. In addition, DRCOG staff may consider implementing friendly rider competitions to help increase ridership and track the number of rides.

Funding sources:

Government organizations

- The Federal Emergency Management Agency and the U.S. Environmental Protection Agency could be sources of grant funding.

- The Federal Emergency Management Agency Transit Security Grant Program provides funding to public transportation systems (intra-city bus, ferries and all forms of passenger rail) to protect critical transportation infrastructure and the traveling public from terrorism, and to increase transportation infrastructure resilience.
- State and regional agencies such as the Colorado Department of Local Affairs, Denver Council of Regional Governments, Colorado Department of Transportation, the Regional Transportation District, and the Colorado Department of Public Health and the Environment could also provide funding through grants and other programs.
- The Regional Transportation District could support writing and applying for grant opportunities.
- The Denver Council of Regional Governments Transportation Improvement Program provides funding for transportation projects in the region.
- Local governments can also be grant recipients or administrators of state and federal rebate and incentive programs. Downtown authorities and urban renewable agencies could also provide funding.

Private sector

- Drive Clean Colorado could help secure funding for the purchase of electric vehicles and charging infrastructure.
- Automobile companies could also support the transition to electric vehicles by obtaining funding through grants, rebates and incentives, and lowering consumer costs.

Funding mechanisms

- Grants, rebates and incentive programs.
- Tax increment financing.

Geographic reach

The Climate Pollution Reduction Grant Planning Area will be the primary focus area for this program and other geographic and demographic considerations identified such as urban, rural and suburban land uses.

Transportation implementation measure No. 2:
Regional active transportation network expansion

Expansion and greater connection of the Denver region's active transportation network, reducing vehicle miles traveled and providing safe, connected travel options for active transportation modes.

Stakeholders and DRCOG Staff will coordinate with regional transportation agencies, including, but not limited to, the Colorado Department of Transportation, the Denver Regional Council of Governments, the Regional Transportation District, and local jurisdiction planning departments to expand active transportation infrastructure in the regio. Facilities will include bike lanes and shared-use paths, prioritizing low-income and disadvantaged communities and key corridors using frameworks established by participating agencies. Infrastructure projects will align with adopted plans for respective project areas, with a focus on first- and last-mile connectivity and the completion of missing links in the regional network.

Low-income disadvantaged communities benefits

- Improves both health and air quality.
- Supports a transportation option that benefits households without a vehicle

- Enables users to avoid congestion.
- Bicycles provide a more affordable and environmentally friendly transportation mode compared to a single occupancy vehicle.

Cost

DRCOG staff modeled costs for a regional active transportation network expansion using existing estimates from a Denver Moves study of sidewalk expansion and cost estimates from The University of North Carolina Safety Research Center. Staff collected additional bike lane cost estimates from a *Denverite* interview with staff of Denver's Department of Transportation and Infrastructure. Costs for sidewalks and bike lanes are highly variable depending on the type and placement, so average costs are estimates.

Table 21. *Cumulative costs and costs per mile of active transportation infrastructure added from this measure. Source: Lotus Sustainability.*

Strategy	Miles added 2025 through 2050	Cost per unit (miles)	Total costs 2025 through 2050
Expand active transportation	1,414	295,485	$417.9 billion

Greenhouse gas impact

This measure includes expanding bike and pedestrian facilities and improving active transportation infrastructure to encourage residents and visitors to switch from vehicles to active modes for short trips. This strategy does not have specified types, or scale, of projects to be completed. The model employs two scenarios for estimating impacts:

- DRCOG staff estimated the lower bound based on the remaining length of the missing links in the active transportation network. This includes 446 miles of pedestrian and bike trails. Some of this mileage was identified as having greater greenhouse gas reduction potential due to being planned in pedestrian focus areas or short trip opportunity zones. Greenhouse gas reductions from these additional miles of active transportation network were estimated based on factors from the Colorado Department of Transportation Greenhouse Gas Mitigation Measures Policy Directive. This method sets the lower bound as it is only based on the completion of the existing network and does not include additional measures to expand the network.
- DRCOG staff estimated the upper bound based on the total maximum potential greenhouse gas reductions possible through active transportation network expansion. Staff estimated maximum possible percent reduction from pedestrian network expansion based on National Household Transportation Survey data.

Table 22. *Cumulative greenhouse gas emissions reductions overall and per mile for the upper and lower bounds of expanding active transportation infrastructure in the planning area. Source: Lotus Sustainability.*

Strategy	Cumulative greenhouse gas reductions 2025 - 2050 (metric tons)	Cumulative greenhouse gas reductions per mile 2025 - 2050 (metric tons)
Expand active transportation infrastructure: lower bound	21,428	2.6
Expand active transportation infrastructure: upper bound	1,009,692	N/A

Co-pollutant impacts

This measure supports a transportation option that reduces particulate matter and ozone precursor emissions. Ozone precursors include volatile organic compounds and nitrogen oxides. Data was incomplete at the time of plan development; therefore, staff were unable to calculate exact co-pollutant reductions for this measure.

Implementation timeline and milestones

DRCOG staff are currently working with jurisdictions in the region to identify priorities, set goals, and set aggressive timelines to achieve active transportation network expansion goals.

Key implementing agencies

Government organizations

- Local governments adopt zoning incentives or requirements for active transportation such as sidewalk repair, bus stop improvements, bike storage and parking reductions.
- The Colorado Department of Transportation.
- The Regional Transportation District's technology program to help older adults and people who don't speak English as a first language navigate transit applications more easily.
- Denver Regional Council of Governments.

Community organizations and commissions

Commerce City's Environmental Policy Advisory Committee, which promotes the environmental effects of public transit and active transportation.

- Denver Streets Partnership.
- Local advocacy organizations.

Housing organizations

- The Colorado Housing Finance Authority works with developers to ensure communities aren't displaced as infrastructure improvements and connectivity improvements occur, and ensures affordable housing is built around transit centers.

Metrics for tracking progress

Metrics for tracking program progress and success include the following:

- Housing density and income.
- Vehicle miles traveled.
- Electric bike sales.
- Crash statistics.
- Miles of sidewalk completed or repaired.
- Trips completed on time.
- Electric vehicle registrations and electric vehicle infrastructure.

Other considerations for tracking include the use of Denver Regional Council of Government's Way to Go program, which promotes transportation options and employer incentives for promoting non-drive-alone trips. In addition, DRCOG staff will consider implementing friendly rider competitions to help increase ridership and track the number of rides taken.

Funding sources:

Government organizations

- Federal government entities such as the Federal Emergency Management Agency and the Environmental Protection Agency could be sources of grant funding.
- The Federal Emergency Management Agency Transit Security Grant Program provides funding to public transportation systems (intra-city bus, ferries and all forms of passenger rail) to protect critical transportation infrastructure and the traveling public from terrorism, and to increase transportation infrastructure resilience.
- State and regional agencies such as the Colorado Department of Local Affairs, Denver Council of Regional Governments, Colorado Department of Transportation, the Regional Transportation District, and the Colorado Department of Public Health and the Environment, could also provide funding through grants and other programs.
- The Regional Transportation District could support writing and applying for grant opportunities.
- Denver Council of Regional Governments Transportation Improvement Program provides funding for transportation projects in the region.

- Local governments can also be grant recipients or administrators of state and federal rebate and incentive programs. Downtown authorities and urban renewable agencies could also provide funding.

Private sector

- Drive Clean Colorado.
- Automobile companies.

Funding mechanisms

- Grants, rebates and incentive programs.
- Tax increment financing.

Geographic reach

The Climate Pollution Reduction Grant Planning Area is the primary area of focus for this program. However, staff identified other geographic and demographic considerations such as urban vs. rural and suburban. For implementation, micromobility may be a priority in suburban areas, while bus rapid transit may be better suited at an urban and regional level. Various interventions will likely need to be evaluated by stakeholders and DRCOG staff based on the distinct qualities of each geographic area within the planning area.

Implementation measures overview

During the stakeholder engagement process, staff and participants selected six implementation measures: four focused on the building sector and two on the transportation sector. (Staff subsequently identified two additional supportive measures.) At the time of plan publication, DRCOG staff and regional stakeholders had yet to determine specific targets for every measure. Staff used specific, existing goals for some measures — specifically transportation, for which analysis and study had been completed prior to this. As staff set targets for the remaining measures, decisions will be contingent on available funding, local government and policy coordination, behavior change and workforce availability. Considering all outstanding information, DRCOG staff evaluated standardized adoption and compliance scenarios for measures that rely on adoption rates to determine their impact.

For the building sector, scenarios explore the percentage of total buildings that will be decarbonized by 2050 based on the specific measure. Staff evaluated the active transportation infrastructure expansion using two methodologies to develop a lower bound and an upper bound of emissions reduction potential.

The high, medium, and low adoption scenarios are described in Table 23.

Table 23. *Outline of the high, medium and low adoption scenarios for proposed buildings and transportation measures. Source: Lotus Sustainability.*

Sector	Measure description	High adoption scenario	Medium adoption scenario	Low adoption scenario
Buildings	Commercial, multifamily, Municipal, university, school, hospital building electrification and efficiency upgrades	100% adoption	50% adoption	25% adoption
Buildings	Multifamily property building decarbonization	100% adoption	50% adoption	25% adoption
Buildings	Residential building electrification and energy audits	100% adoption	50% adoption	25% adoption
Buildings	Free home weatherization and energy efficiency services: low-income and disadvantaged communities	100% adoption	50% adoption	25% adoption
Transportation	Regional bus rapid transit expansion	Not applicable	Not applicable	Not applicable
Transportation	Regional active transportation network expansion	Upper bound of impact	Lower bound of impact	Lower bound of impact

Business-as-usual and impact modeling of identified measures

The business-as-usual carbon emissions model illustrates the region's buildings and on-road transportation emissions in 2050 if no additional regional climate pollution reduction measures are implemented. In addition, the model demonstrates the overall potential of measures to reduce greenhouse gas emissions in each sectors.

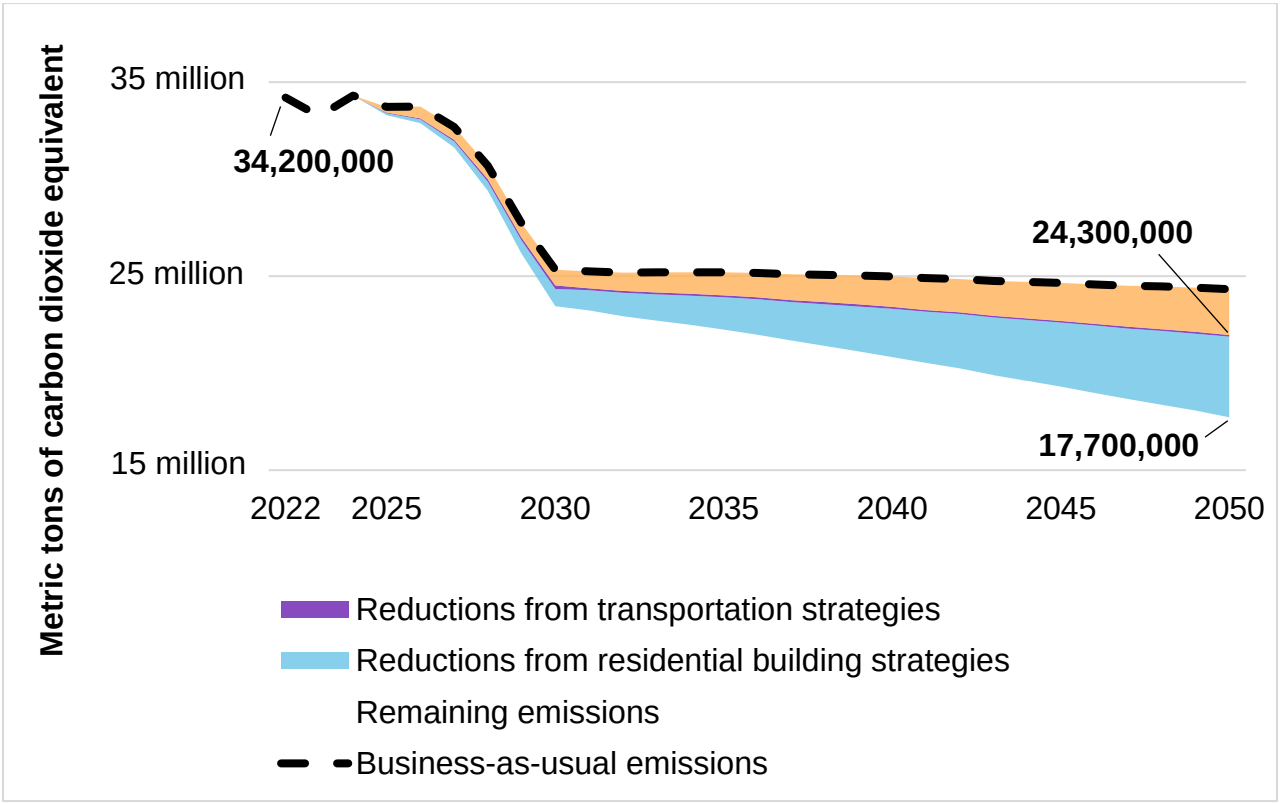
The business-as-usual scenario assumes that by 2050, 74.6% of energy is renewable and 25.5% of vehicles are electric.

High adoption scenario

The high adoption scenario detailed in Figure 7 demonstrates the greenhouse gas emission reductions from the buildings and transportation sectors compared with the business-as-usual case by 2050 if 100% of buildings are decarbonized and the upper bound of impact from the active transportation expansion measure is achieved.

This scenario achieves a 27% reduction in emissions.

Figure 7. *Scenario considering high adoption for buildings and upper bound adoption for transportation. Source: Lotus Sustainability.*

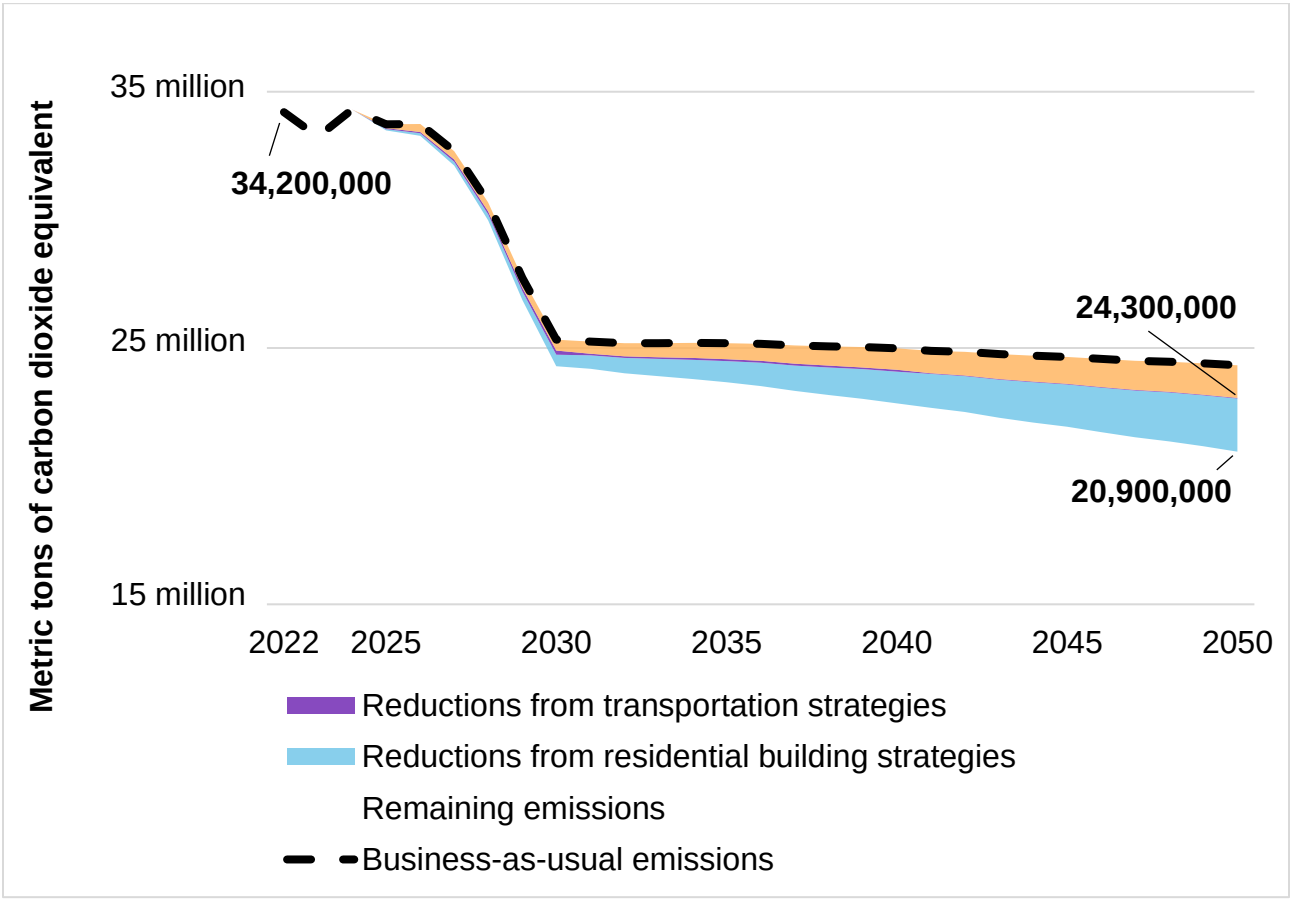


Medium adoption scenario

The medium adoption scenario depicted in Figure 8 demonstrates the greenhouse gas emission reductions from the buildings and transportation sectors compared with the business-as-usual case by 2050 if 50% of buildings are decarbonized and the lower bound of impact from the active transportation expansion measure is achieved.

This scenario achieves a 14% reduction in emissions.

Figure 8. *Scenario considering medium adoption for buildings and lower bound adoption for transportation. Source: Lotus Sustainability.*

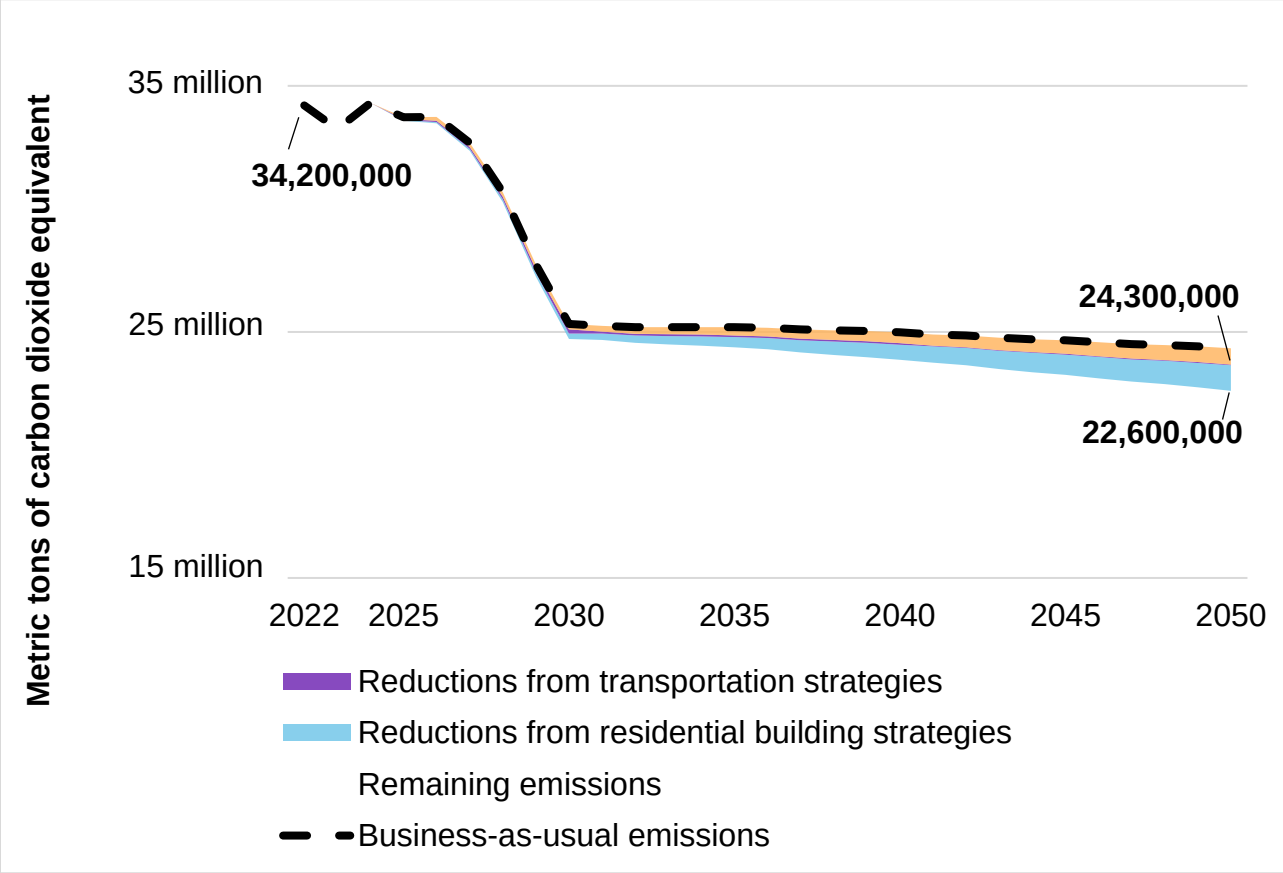


Low adoption scenario

The low adoption scenario conveyed in Figure 9 demonstrates the greenhouse gas emission reductions from the buildings and transportation sectors compared with the business-as-usual case by 2050 if 25% of buildings are decarbonized and the lower bound of impact from the active transportation expansion measure is achieved.

This scenario achieves a 7% reduction in emissions.

Figure 9. *Scenario considering low adoption for buildings and lower bound adoption for transportation. Source: Lotus Sustainability.*



The benefits of implementing measures will be amplified by other climate pollution reduction measures being considered at the state and federal levels, specifically the increased use of renewable energy to power buildings and further investment in a comprehensive, multimodal transportation system.

DRCOG's review of authority to implement

Per the U.S. Environmental Protection Agency's requirements, the Priority Climate Action Plan must identify if relevant state or local governments' existing statutory or regulatory authorities are adequate to implement identified measures, or if such authority must be obtained. None of the measures enacts any form of regulation or policy – the measures in this plan consequently do not require any statutory or regulatory authority to implement. This chapter therefore identifies the Denver Regional Council of Governments' role in implementing each of the strategies.

Role in residential building strategies

DRCOG's Climate Pollution Reduction Grant stakeholders recommended that DRCOG's primary role in the Climate Pollution Reduction Grant program be to connect all stakeholders (such as organizations, jurisdictions and contractors), ensure equitable distribution of funding and incentives, and track and report progress.

Role in commercial building strategies

There are three themes regarding DRCOG's role in implementing programs related to commercial and multifamily buildings:

Theme 1 – Provide resources to member governments and partners.

- Administer a central website for information that connects municipalities or building owners with installers, lists frequently asked questions and case studies, and shares the state's geothermal resources map.
- Administer a central database of information relevant to buildings and the equipment in buildings (for example, the type of fuel various pieces of equipment use, building square footage and building use).

Theme 2 – Building decarbonization administration assistance.

- Compile and administer rebates and disperse information on tax credits.
- Pass funding through to local governments for municipal, university, school, and hospital buildings.
- Track and report program metrics.

Theme 3 – Serve as a convenor.

- Facilitate changes to permitting processes when necessary or connect local governments with each other to learn how to make it easier to install electric instead of gas appliances in buildings.
- Identify gaps in building decarbonization and energy efficiency policies in the region.

- Work with local governments to determine effective regional policy for commercial buildings as well as policy administration.

Role in transportation strategies

Climate Pollution Reduction Grant stakeholders recognized DRCOG's established role in guiding regional transportation dialogue and planning. They elected to capitalize on this role, leaning on DRCOG to leverage existing resources in identifying federal funding, helping local government staff and elected officials understand regional needs and maximizing value for transportation and climate challenges alike.

DRCOG staff will continue to prioritize the measures established in this plan, engage the public on ongoing mobility and accessibility needs and facilitate discussion among local government leaders surrounding action and implementation.

Role in workforce strategies

Attendees at the implementation workshop suggested the primary roles DRCOG staff should take on were helping to secure funding, particularly for women, Black communities, Indigenous communities, and people of color. Attendees also suggested DRCOG act as a coordinating body and lead the marketing and promotion of workforce programs. More specifically, stakeholders indicated DRCOG staff ensure data standardization across the region, use American Climate Corps for culturally salient outreach, standardize certifications for decarbonization-focused contractors and laborers, act as a central repository for data and electrification contractors, and track metrics and the progress of the workforce development program.

Role in centralized administration strategies

Participants suggested that DRCOG's leadership should position it as the primary administrator of the programs that develop from the Priority Climate Action Plan strategies. As administrator, DRCOG staff will convene partners and representatives of key sectors; help secure implementation funding; help stakeholders navigate the various program components such as compiling and administering appliance and installation rebates and information about tax credits; support development of decarbonization-focused contractor certification and qualification lists; and contract with vendors. Stakeholders suggested DRCOG staff could help identify policy changes that reduce climate pollution in the region, support elected officials and communicate regional priorities, and ensure equitable distribution and deployment of workforce development programming. Additionally, stakeholders suggested that DRCOG staff could assist with changes to the permitting process by passing grand funds to municipalities for multifamily buildings, universities, schools and hospitals.

Workforce planning analysis

As the Denver region's communities commit to reducing greenhouse gas emissions through the measures outlined in this Priority Climate Action Plan, a skilled and adaptable workforce will be necessary to propel progress toward measures and a clean energy economy. As communities adopt strategies to achieve the measures in this plan, demand for public sector collaboration and private sector solutions is likely to increase. Such a trend will simultaneously address environmental concerns and present an economic opportunity to create well-paying jobs and foster innovation in the renewable energy and sustainability sectors.

This chapter summarizes staff and committee evaluation of the existing and potential workforce needs to implement the plan's identified measures. It outlines current workforce trends, challenges and opportunities within the state's clean energy industry, and specifically the Denver region.

Clean energy workforce in Colorado

Overview

Every energy sector in the state of Colorado grew from 2021 to 2022, with fuels and energy efficiency growing the most, and energy efficiency making up the largest portion of clean energy jobs in the state. Fuels employment includes jobs in the agriculture and forestry, mining and extraction, construction, manufacturing, trade, and professional services sectors, and includes coal, oil and other petroleum, natural gas, corn ethanol, other ethanol/non-woody biomass and woody biomass. In 2022, the largest trades within the energy efficiency sector in Colorado were Energy Star construction, efficient lighting, and heating, ventilation and air conditioning.

Summary of workforce data

According to the U.S. Energy and Employment Report 2023, from 2021 to 2022, the number of jobs in the energy sector in Colorado increased by 5%. Specifically, clean electric power jobs depicted in Table 24 increased by 4%.

- Renewable electric power generation technologies.
- Nuclear electric power generation and fuel.
- Microgrids and grid modernization.
- Non-fossil fuel energy storage.
- All biofuels.
- Plug-in hybrid vehicles.
- Battery electric vehicles.
- Hydrogen fuel cell vehicles.
- All energy efficiency.
- Traditional transmission and distribution (including that which is associated with fossil fuels).

The growth in each energy sector, as reported in the E2: Clean Jobs Colorado 2023, follows and is illustrated in Table 24.

Fuels:

- 3,519 new jobs, a 12% increase.
- Mining and extraction represented 55% of fuel jobs in Colorado.

Energy efficiency:

- 1,642 new jobs, a 5% increase.
- Energy efficiency employment was primarily within professional and business services and construction.

Motor vehicles and component parts (including electric vehicles):

- 241 new jobs, a 4% increase.
- Repair and maintenance represented the largest proportion of this sector.

Transmission, distribution and storage:

- 324 new jobs, a 1% increase.
- Utilities represented 30% of the sector's jobs.

Electric power generation:

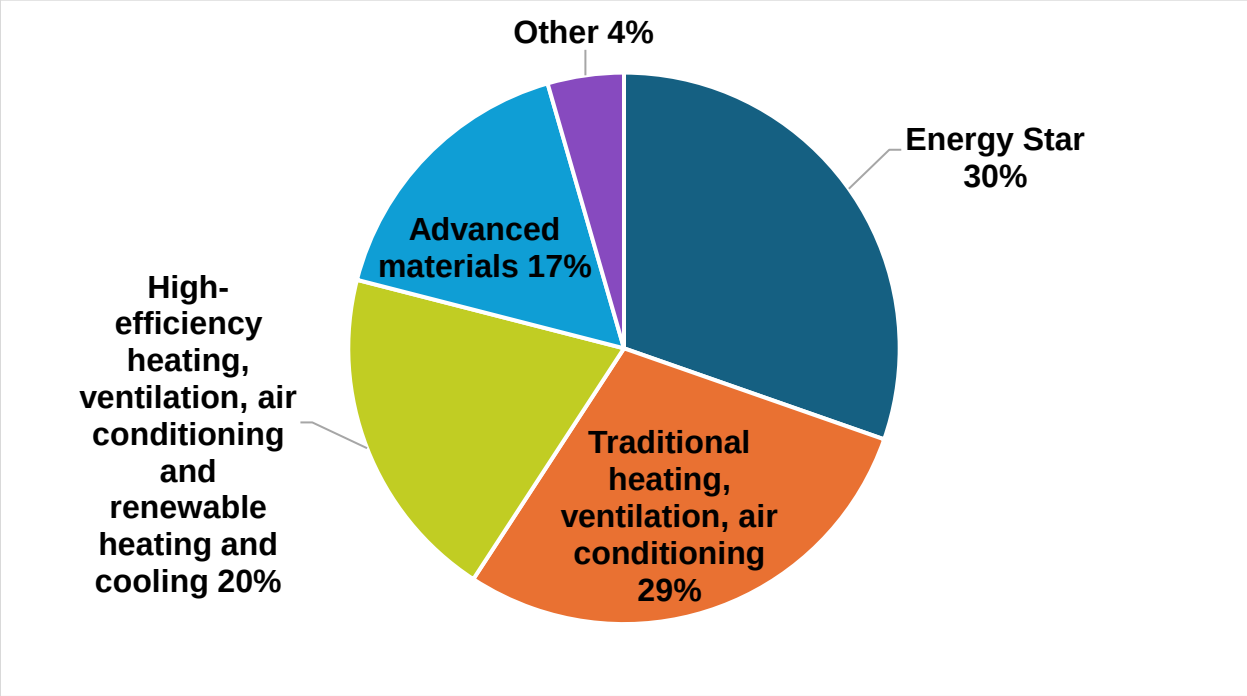
- 259 new jobs, a 1% increase.
- Electricity generation from solar and wind technology made up the largest portion of technology applications within the electric power generation subsector.
- Professional and business services were the largest industry subsector in electric power generation, making up 62% of jobs.
- Construction was the next largest industry subsector, with 21% of jobs.

Table 24. *Employment by major energy technology application in Colorado from 2020 to 2022. Source: E2: Clean Jobs Colorado 2023.*

Energy employment sector	2020	2021	2022	Percent change between 2020 and 2022
Electric power generation	17,324	17,625	18,022	**4% growth**
Fuels	1,959	1,987	1,978	**1% growth**
Transmission, distribution and storage	2,912	3,044	3,240	**11.3% growth**
Energy efficiency	32,595	34,205	35,847	**10% growth**
Motor vehicles	3,224	4,129	4,693	**45.6% growth**

In 2022, the energy efficiency sector made up the largest portion of clean energy jobs in Colorado, with just under 36,000 jobs, the majority being contractors and trades focused on Energy Star construction, efficient lighting, heating, ventilation, and air conditioning, and other building and efficiency-related trades (Environmental Entrepreneurs, 2023). Table 24 illustrates clean energy employment by sector, and Figure 10 illustrates employment within the energy efficiency sector in Colorado.

Figure 10. *Breakdown of employment in Colorado in the energy efficiency sector in 2022. Source: Environmental Entrepreneurs, 2023.*



Finally, a report by Center for the New Energy Economy at Colorado State University found that Colorado had over 140,000 energy workers in 2021, which included over 34,000 workers employed in energy efficiency. About 24% of Colorado's clean energy jobs were in rural areas of the state (Center for the New Energy Economy 2022). These reports detail that Colorado experienced job growth within the energy efficiency trades and were among the highest in energy related jobs.

Expected growth in the energy industry in Colorado

DRCOG staff used its data analysis related to the expected growth of the clean energy workforce to inform its key takeaways for this section. Staff used data provided by the Political Economy Research Institute at the University of Massachusetts Amherst, the U.S. Energy and Employment Report 2023, and the 2023 Beneficial Electrification Workforce Development Ecosystem (Beneficial Electrification Workforce Development) Report developed for the City and County of Denver (Brendle Group, and Collaborative Climate, 2023).

Key takeaways

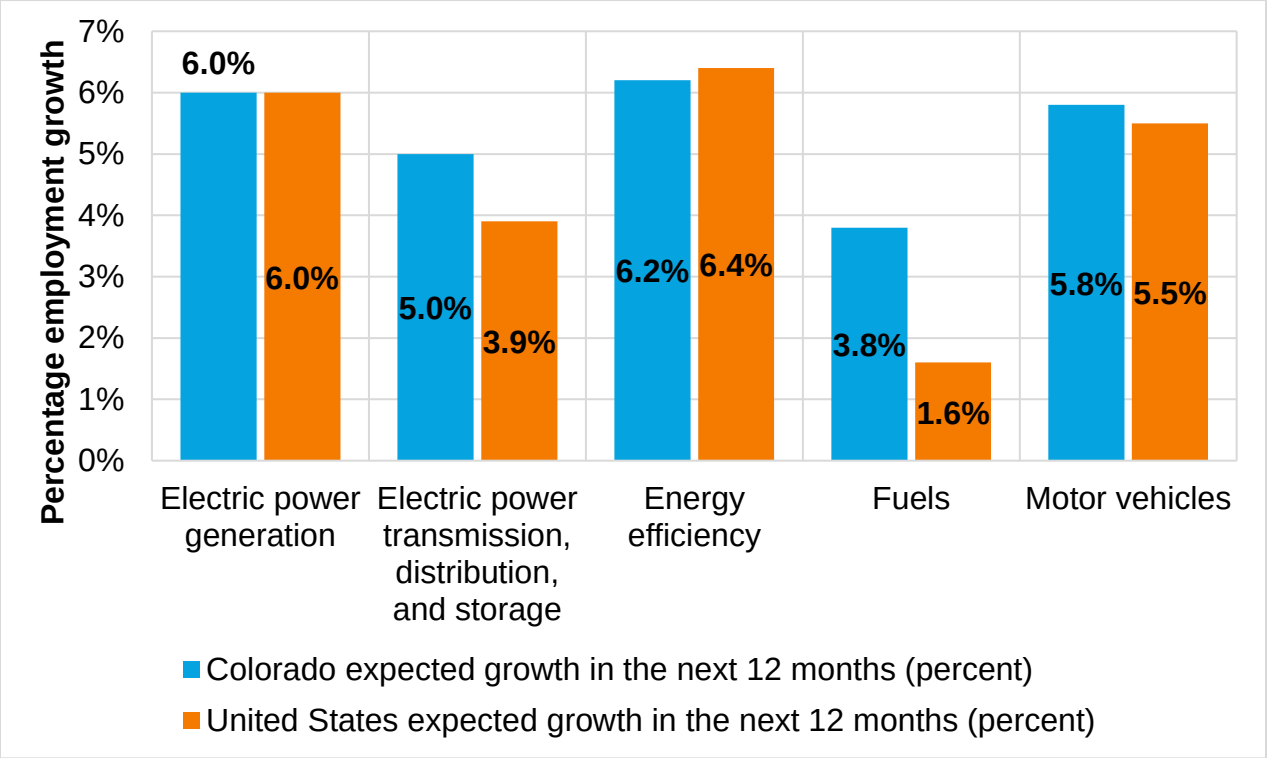
Colorado is expected to experience, at minimum, a 5% growth in 2024 in key new technology sectors, with energy efficiency and motor vehicles expected to present the highest growth. The key new technology sectors do not include the fuels sector, which grew 3.8% in from 2021 to 2022. In addition, to meet the state's climate goals, Colorado's government and public and private sectors would need to invest significantly in the clean energy industry, with potential to generate around 100,000 new jobs by 2030.

Summary of workforce data

A study conducted by the Political Economy Research Institute estimates that significant investment would be required for Colorado to meet its goal of reducing carbon dioxide emissions 50% by 2030 and 90% by 2050. Total investments in energy efficiency and renewable energy alone would need to average about $14.5 billion per year from 2021 through 2030. Ultimately, this would generate approximately 100,000 jobs per year in Colorado.

According to the U.S. Energy and Employment Report 2023, Colorado is expected to see major growth in many areas of new technology, several of which relate directly to clean energy. Figure 11 highlights the expected growth in Colorado by major technology applications. According to the study, energy efficiency technology is expected to have the greatest jobs increase at over 6%.

Figure 11. *Expected near-term job growth by major technology application. Source: U.S. Energy and Employment Report 2023.*



The Beneficial Electrification Workforce Development Report provides workforce data related to residential building electrification, particularly heating, ventilation, and air conditioning and heat pumps within the Denver metropolitan area and throughout the state. The report indicates three growth scenarios for new or newly trained residential heat pump installers relative to the total heating, ventilation and air conditioning workforce in the Denver region. One of the scenarios shows that the metropolitan area must reach an annual 23% increase for new or newly trained heat pump installers to ensure that 100% of heating, ventilation and air conditioning installers are able to install heat pumps for customers by 2035. The report illustrates the importance of nurturing and training the existing workforce on heat pump technologies and installation at a rapid rate that can be easily scaled across the state.

For Colorado to meet its robust climate goals, it's apparent that significant growth must happen in the clean energy sectors.

Current challenges and opportunities in Colorado's clean energy workforce

This section provides an overview of current gaps in Colorado's clean energy workforce and details the barriers stunting the state's workforce expansion. In its analysis, staff used data from the 2023 U.S. Energy and Employment Report 2023, E4TheFuture's 2023 Energy Efficiency Jobs in America-Colorado report, the Beneficial Electrification Workforce Development Report, and insights from reports and discussions with The Common Thread, a Denver-based consulting firm focused on reducing labor turnover in the construction industry.

Overview

Colorado's clean energy workforce faces several challenges to meeting the increasing demands for workers in electrification, energy efficiency and other clean energy trades. The lack of diverse racial, ethnic and gender representation with the workforce creates barriers to widespread recruitment and access to opportunities in these industries, such as cultural differences, which can lead to higher turnover rates.

With rapid advances in clean energy technology, the state's current energy industry employees don't have the knowledge, skills and training to provide the most innovative solutions. Stakeholders indicated that DRCOG staff should encourage industry leaders to pursue robust, targeted recruitment, training and education programs to reskill and upskill their workers.

Gaps in Colorado's clean energy workforce demographics

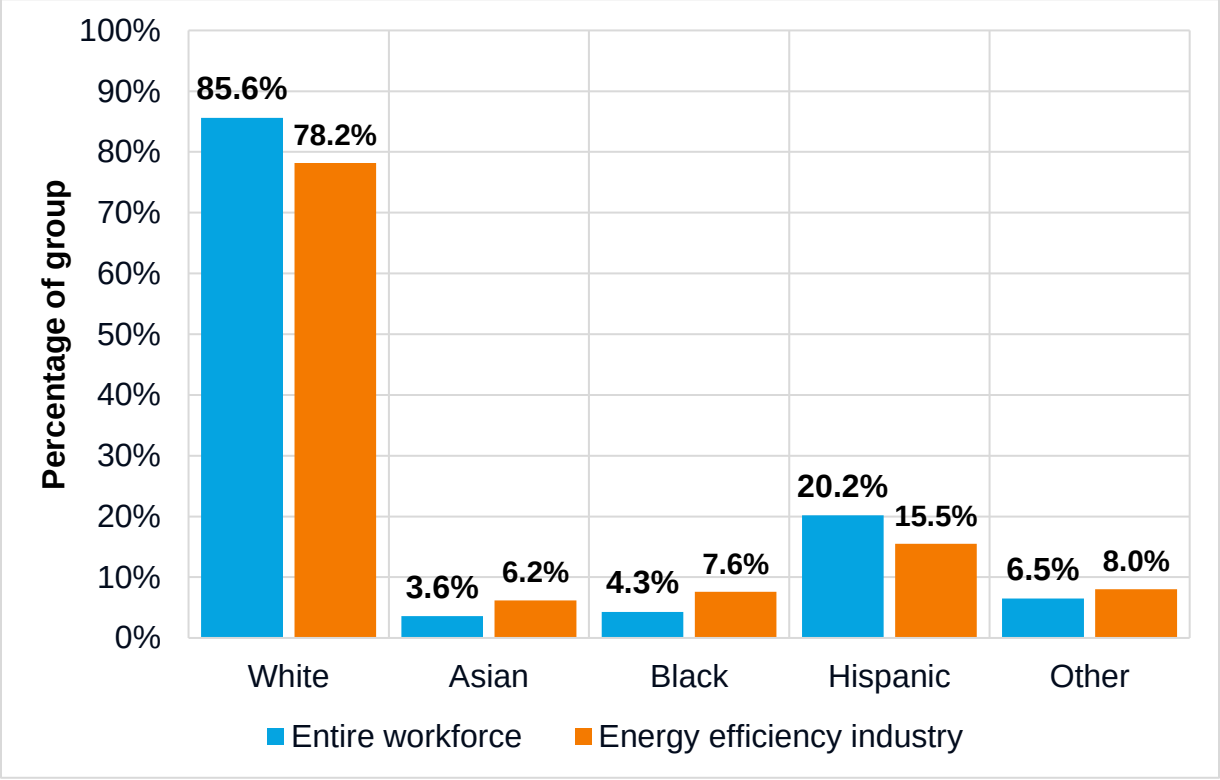
The clean energy industry is made up of predominantly male workers, many of whom are 40 or older (Brendle Group and Collaborative Climate, 2023). The lack of diversity and representation of Black, Indigenous, People of Color in the clean energy industry can present cultural and generational challenges within the workplace and can lead to

high turnover rates. Promoting diversity and inclusive practices within trades and clean energy companies can help create a larger and more resilient workforce.

The 2023 U.S. Energy and Employment Report 2023 report found that nationally in 2022, the energy workforce was primarily male, with men making up 73% of the workforce. Participation in the energy workforce by women increased by 8% in 2022, meaning that over half of the net new energy jobs added in 2022 were held by women. Gender nonbinary workers made up less than 1% of the energy workforce.

The report also found that non-white workers made up about 24% of the energy workforce in 2022. Hispanic or Latino workers represented about 18% of the energy workforce, and Asian Americans accounted for about 7%.

Figure 12. *Race and ethnicity in the Colorado energy efficiency industry in 2022. Source: E4TheFuture, 2023. **



*In Figure 12, “White” includes both non-Hispanic and Hispanic white people.

Staff analysts discovered similar data in the E4TheFuture report, which noted that in 2022 about 78% of the energy efficiency industry in Colorado was white, and women only made up about 28% of the energy efficiency workforce (as reported in Figure 12).

In 2019, the Energy Efficiency Business Coalition, a statewide trade association to increase the business potential of the energy efficiency industry, surveyed its trade members. It asked member companies to identify their most important business needs. Half of respondents indicated their most important need was to attract younger workers

and identify a broader labor pool (The Common Thread). Additionally, the U.S. Energy and Employment Report 2023 found that 47% of the state's energy industry employers reported hiring difficulty. According to the Beneficial Electrification Workforce Development Report, probable causes of hiring issues in the clean energy industry also include language barriers amongst potential hires, lack of awareness of quality job opportunities for potential employees which make it difficult for contractors to meet hiring needs and lack of diversity, equity and inclusion practices.

Gaps in Colorado's recruitment and retention of the clean energy workforce

Studies indicate that growing the current energy workforce must be accompanied by robust recruitment and retention programs. The Beneficial Electrification Workforce Development Report highlighted the large number of workers in the building electrification trade transferring out of their occupation or exiting the industry altogether, as conveyed in Figure 13. Industry attrition could be attributed to an aging workforce, lack of training and upskilling opportunities, language barriers and lack of access to job opportunities, and limited hiring efforts (Brendle Group and Collaborative Climate, 2023).

Figure 13. *Colorado statewide annual workforce openings for key building electrification-related occupations from 2022 to 2032. Source: Brendle Group and Collaborative Climate, 2023.*

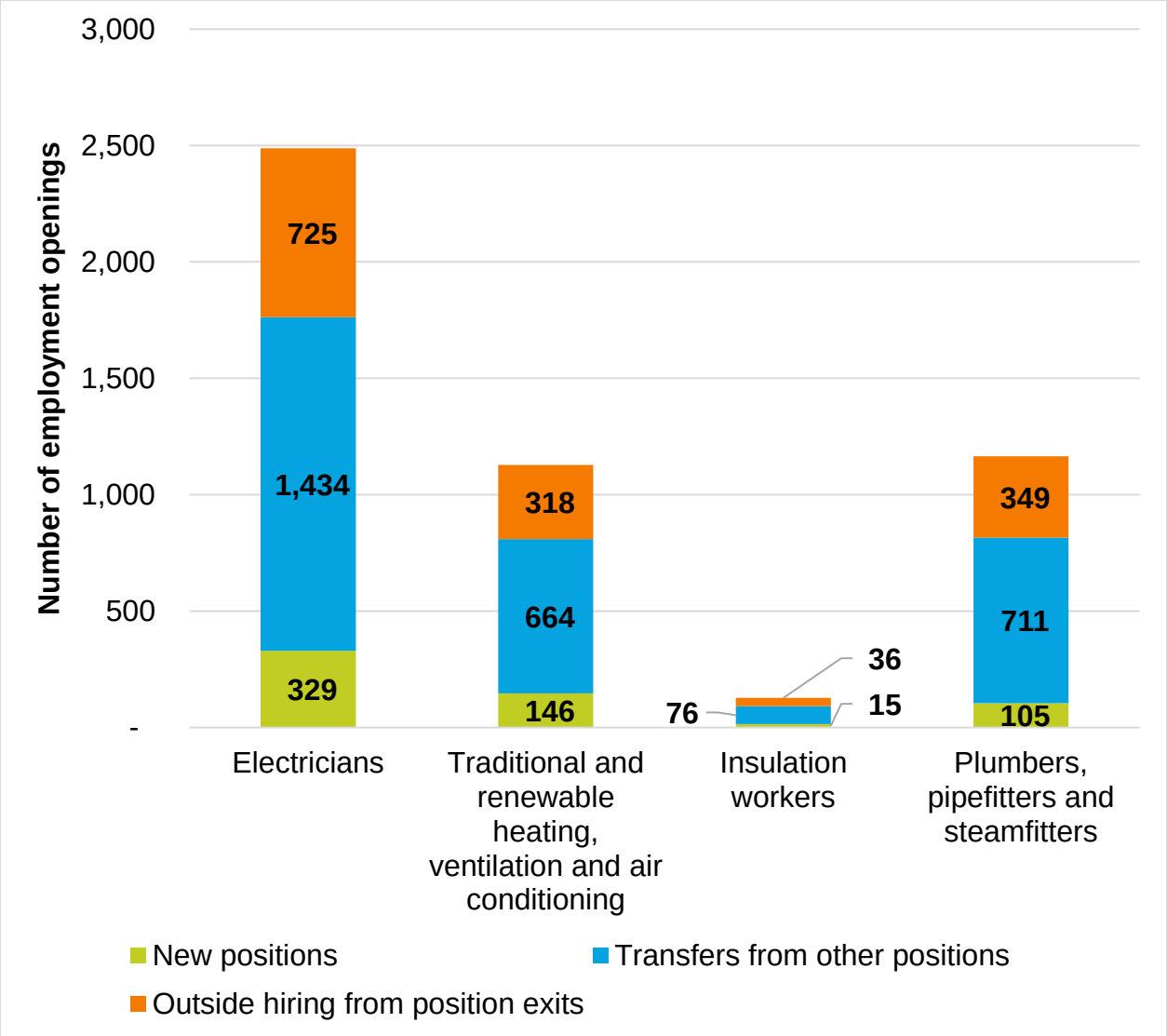


Figure 13 details Colorado's projected annual workforce openings between 2022 and 2032 for key building electrification-related occupations. The data in Figure 13 demonstrates challenges with the current workforce and the anticipated openings, also accounting for a small amount of growth in the sector overall from 2022 to 2032. These metrics include the workforce serving both residential and nonresidential properties. In order for Colorado to maintain an adequate clean energy and building electrification workforce, plan stakeholders recommend that industry leaders improve recruitment and retention within the building electrification.

A study conducted by The Common Thread examining labor turnover challenges among three of the largest insulation and air sealing corporations nationwide found that for every 10 newly hired technicians, the contractor would lose six new hires within a

few months. The study also found that for every four retiring construction employees, only one younger worker would enter the industry to replace them. Such nationwide statistics point to systemic issues for the energy workforce, including an aging population and high turnover rates and suggest the potential value of programs to recruit and retain new workers.

Gaps in Colorado's clean energy workforce skills and training programs

Nationwide trends reveal building electrification and its associated technologies, such as heat pumps, are key to transitioning Colorado's buildings into cleaner heating and cooling solutions. Workforce data reveals barriers to adequate enrollment in training and certification programs, exacerbating workforce gaps in the clean energy industry.

The Beneficial Electrification Workforce Development Report found that only 10% of Colorado's heating, ventilation and air conditioning contractors serving residential properties are participating in heat pump utility incentive programs, corresponding to just 491 individuals trained in heat pump technology and installation. The report also found that 52% of heating, ventilation, and air conditioning workforce services residential projects and, of that 52%, only 9.6% participate in heat pump incentive programs. The report also noted the need for 23% annual growth in heating, ventilation and air conditioning contractors (serving residential properties) trained in heat pump technologies.

Within the construction industry, The Common Thread reported that Colorado will need around 220,000 construction workers by 2027, which means the state must attract 8,000 workers to the construction workforce annually between 2024 and 2029. Similarly, the projected growth of new technology sectors and clean energy workforce needs (reported in the previous sections on energy industry growth in Colorado) indicate the need for a highly skilled workforce to meet these demands.

The Beneficial Electrification Workforce Development Report found that while training programs exist across the state, widespread enrollment is lacking due to financial constraints, inadequate marketing and awareness of programs by potential employees, lack of uptake on heating, ventilation, and air conditioning heat pump technologies residentially and commercially, and lack of emphasis on equity and inclusion in upskilling efforts by contractors.

In the fall of 2023, Xcel Energy staff surveyed 23 heating, ventilation and air conditioning contractors to better understand their opinions around air-source heat pumps and future training. The report found that over 50% of respondents indicated "difficulty finding heat pump trained workforce" as the number one barrier, with current lack of training an difficulty acquiring heat pumps (supply chain issues) as other key issues (Brendle Group and Collaborative Climate, 2023).

Such findings underscore the need to provide workforce with access to training and education programs to provide them with the necessary skills to keep pace with

technological advancements in heat pumps, energy efficiency upgrades and other clean energy trades.

Data reveals that Colorado's clean energy industry is rapidly growing, particularly in the energy efficiency sector, but the workforce needed to support the state's decarbonization efforts must overcome several barriers to a skilled workforce. Stakeholders recommend targeted and equitable recruitment and retention efforts be leveraged to expand the prospective workforce and connect them with training programs across the state to help meet the demand for heating, ventilation, air conditioning and other trades in the clean energy industry.

Key takeaways

Colorado's clean energy workforce is rapidly growing and driven by the state's industry shift toward a greener economy and commitment to sustainability. However, the state's current workforce has not met the demand for the skilled workers needed to support the building electrification, energy efficiency and other clean energy trades. Many challenges are thwarting the growth of Colorado's clean energy workforce, but lack of opportunity and access to training and education, inadequate recruitment and retention efforts, and lack of diversity, equity, and inclusion are among the most challenging. Overcoming such challenges are among the most essential elements to stakeholders to ensure demand in the clean energy space is met rapidly, sustainably and equitably.

Next steps

The Priority Climate Action Plan development process demonstrates that the Denver region is ready for immediate climate action to drive greenhouse gas and co-pollutant emissions reductions, all while supporting low-income and disadvantaged communities through climate pollution reduction measure implementation. Stakeholders from across the region engaged with DRCOG staff throughout plan development, providing input on the measures outlined in the plan and how those measures should be implemented across the region.

Under the expanded scope of the Comprehensive Climate Action Plan, DRCOG staff will consider sectors like agriculture, oil and gas waste, and others as identified in the regional greenhouse gas inventory. The climate pollution reduction measures in the comprehensive plan will identify opportunities for market transformation toward a low-carbon economy, supporting both the State of Colorado's and regional stakeholders' goals for greenhouse gas reduction. In addition, DRCOG staff intend to expand public engagement and outreach efforts to marginalized community members and identify measures that will improve the lives of communities within the region through climate pollution reduction.

DRCOG staff and regional stakeholders will begin the planning process for the Comprehensive Climate Action Plan in April of 2024 through interactive, staff-facilitated meetings where stakeholders will be asked to identify priorities and goals for the successive planning process. Initial stakeholder meetings will be formalized into a work plan that will guide DRCOG staff's additional climate planning work through 2025.

Stakeholders in the Denver region have — through collaboration and individual initiatives — been propelling climate action for the last two decades. The regional climate action planning processes initiated through the Climate Pollution Reduction Grant will amplify and accelerate existing local and regional actions to support a regional transformation to a low-carbon economy and represents the perspectives of all residents of the Denver region.