Colorado Climate Preparedness Roadmap

DECEMBER 2023

Executive Summary

Colorado will celebrate its 150th birthday in 2026 and turn 200 in 2076. As we imagine what we want Colorado to be like at those milestones, we recognize that better understanding, predicting, preparing for and adapting to the realities of a changing climate are foundational to a healthy and prosperous Colorado.

Colorado is already experiencing the impacts of climate change. These trends have been described for decades by the world's foremost climate experts, many of whom call Colorado home. They have long described the realities we now see unfolding in real time. In both large and small ways, Coloradans are being affected by extreme heat and warming temperatures, wildfires, drought, flooding, and combinations of these events. These hazards have very real impacts on natural systems, the built environment, economic sectors, and people and communities, especially those communities that face higher vulnerabilities and disproportionate impacts.

Colorado has important differences from other states and regions. Our elevation, low humidity, topography, and other special characteristics significantly influence how we experience climate change and can provide some notable opportunities and benefits compared with other states or regions.

The Climate Preparedness Roadmap places a focus on climate adaptation — the state's near-term actions to reduce risks and prepare for the future impacts of climate change. At the same time, Colorado continues to be a national leader in reducing Greenhouse Gas pollution, and is concurrently producing its second roadmap focusing on reducing the pollution that causes climate change through the deployment of clean technologies across all sectors of Colorado's economy. While these efforts are coordinated, they maintain distinct areas of focus, analysis and outcomes.

This roadmap shares state government agencies' actionable and achievable near-term steps toward climate adaptation. Included in this roadmap are next-step actions across multiple agencies and offices for near-term implementation. Where needed, these actions are coordinated with any other plans or actions to avoid duplication amongst ongoing state efforts. Updated every three years and based on iterative learning, the Climate Preparedness Roadmap charts the next steps on the path for a climate adapted, healthy, and prosperous future Colorado.

KEY TAKEAWAYS

Colorado Faces Significant Climate Hazards and Risks

Colorado is already experiencing the impacts of climate change. A warming climate is projected to increase these impacts through hazards such as extreme heat, wildfire frequency, and drought, while decreasing snowpack and water availability. These are key hazards with high levels of certainty, and they pose high climate risk to Colorado.

Approaches to Climate Adaptation Must Factor in Colorado-Specific Needs

Adaptation solutions should take into account Colorado-specific needs and Colorado-specific opportunities. Unique characteristics like elevation, dry air and topography will influence how Colorado experiences climate change impacts. Our understandings and interventions should take these into account to support better prioritization, efficiency, and Colorado-specific outcomes.

Climate Risk is a Function of Multiple Interconnected Factors, and Varies Across Colorado

A climate risk assessment layers climate influenced hazards with types of exposure on top of areas of vulnerability to provide an aggregated view of the domains and geographic regions most at risk. By analyzing these interplays, we can better develop Colorado-tailored adaptation strategies and prioritize near-term actions. For instance, extreme heat will have the most pronounced effects on the Eastern Plains and specific areas of the Western Slope, as well as population centers when overlapped with urban heat island effects. The state's overall aging population and disproportionately impacted communities face higher vulnerabilities and exposures to many types of climate impacts.

Near-Term Progress on Climate Adaptation Requires Identifying and Understanding Areas of Focus

The state has and continues to do a great deal on climate resilience and adaptation — even indirectly. This report found several areas that deserve prioritization or continued direct climate adaptation focus, including: extreme heat; adaptation within natural systems including biodiversity; drought and water scarcity; agriculture and outdoor workers; wildfire mitigation and preparedness; compounding impacts such as flood after fire; and areas home to disproportionately impacted and vulnerable communities. In addition, actions supporting improved coordination and collaboration, education and technical assistance, research and integration into existing programs, and community-centered approaches deserve proactive focus. While the state should and will continue to act and adapt to known climate risks throughout state government, new or increased coordinated efforts and focus are important for these priority areas.

About this Roadmap

Introduction

Human-driven climate change is already affecting Colorado. We need look no further than the incredible devastation of the Marshall Fire, the year-after-year record-breaking wildfire seasons, extended drought, and record summertime heat to see firsthand what the science and data have been predicting for decades. Being prepared for the current and future impacts of climate change is not only prudent but an imperative.

First, efforts to reduce the air pollution that causes climate change, including Colorado's nation-leading actions, remains the primary strategy to avoid the harshest effects of climate change, while creating new economic opportunities for Coloradans and stabilizing energy costs. The Colorado legislature has set statewide goals to reduce greenhouse gasses 50% by 2030 from 2005 levels and to achieve net-zero emissions by 2050.[1] Colorado's first Greenhouse Gas Pollution Reduction Roadmap lays out strategies to move the state into closer alignment with these targets. More than 95% of the first roadmap strategies are underway or complete; therefore the state is concurrently working on a second Greenhouse Gas Pollution Reduction Roadmap, which outlines additional actions to continue minimizing greenhouse gas pollution.[2]

Nonetheless, the impacts from climate change are here and will increasingly touch nearly every aspect of life. Climate change is driven by global emissions, and there is momentum in the climate system, so significant warming will take place for decades to come. Recent updates including the National Climate Assessment and United Nations Emissions Gap Report note a trajectory of warming above even the 2 degree C upper-threshold included in this report. With this in mind, better understanding, predicting, preparing for, and adapting to the realities of a changing climate are necessary to pursuing a vibrant, prosperous, and healthy future for Colorado.

A warming climate is increasing extreme heat, wildfire frequency, and drought, while stressing Colorado's snowpack and water availability. The magnitude of these effects will generally increase with the warming climate. Increasing climate change impacts will profoundly affect natural systems, the economy, the built environment, people and communities. These impacts can multiply across sectors, leading to significant additional risks. The climate crisis disproportionately affects communities of color and other populations and communities who already face systemic disadvantages.[3]

Climate change is happening globally, but local factors will determine a number of nuances in how Colorado experiences it. As Colorado undertakes a more proactive and focused approach to climate adaptation, we must consider the Colorado-specific context, using Colorado's strengths and controlling for its weaknesses. While local characteristics can exacerbate some climate impacts, our elevation, low humidity, topography, and other characteristics significantly influence how we experience climate change and can provide notable opportunities and benefits compared with other states or regions.[4]

- Colorado's large amount of protected or undeveloped natural areas relative to many other states, and the influence of elevation provide resilience benefits and connectivity opportunities — the opportunity for species to adapt by moving along with their habitat as the climate changes.[5]

- While heat stress and extreme heat are undoubtedly concerns in Colorado, the state's low relative humidity provides some added safety and benefits to workers when compared with more humid regions.[6]

- While snowpack and runoff are predicted to meaningfully change, the state's elevation helps position Colorado's outdoor recreation industry better than many of its counterparts in lower-elevation states or regions.[7]
- As any Coloradan knows, sun on a winter day can mean T-shirt weather and shade on a summer day can mean adding a light layer of clothing. The state's high elevation and thin atmosphere amplifies the importance of direct sun or shade. This brings opportunities to design buildings, greenspace, or plant shade trees to best utilize the strong influence of direct sun or shade.
- Furthermore, Colorado's elevation and low humidity aid in greater nighttime cooling relative to other states and regions.[8]

Even with these local influences, the warming climate has brought an increasing number of disasters to Colorado. Natural disasters — including wildfires and floods — are projected to increase in frequency and severity by the mid 21st century.[9] Tellingly, the three largest wildfires in Colorado history (Cameron Peak, East Troublesome, and Pine Gulch) all burned in the past three years, and all 20 of the state's largest recorded wildfires have occurred in the last 21 years. The most destructive fire in state history, the Marshall Fire, occurred in 2021.[10]

Risk from climate change comes not only from exposure to a warming climate and the resulting direct physical impacts, but from the vulnerability of the state's population and resources to those physical impacts. For instance, climate risk doesn't just come from extreme heat, but from the increased vulnerability of the state's aging population. The need to better understand, predict, prepare for, and adapt to the realities of a changing climate should view, even if imperfectly, climate impacts through the context of many other interconnected factors, such as population growth, demographic changes, socioeconomics, and ecological data.

Climate Adaptation vs Climate Mitigation

Climate Mitigation

Actions that aim to reduce the root causes of climate change, often by avoiding, reducing, or sequestering greenhouse gas emissions, including carbon dioxide, methane, and other less ubiquitous pollutants like hydrofluorocarbons. ***Think expanding the adoption of renewable energy or electric vehicles.***

Climate Adaptation

Actions taken to reduce current risks and to prepare for future impacts from the changing climate. ***Think wildfire-proofing homes or protecting important wildlife corridors and habitat.***

Outside of preparing for climate impacts (adaptation), the state is separately and aggressively pursuing actions to reduce greenhouse gasses (climate mitigation). Many actions Colorado can take may achieve both purposes, as well as other benefits like reducing energy costs, improving security, and reducing local air pollution. When a particular policy, investment, or action achieves more than one of these or other public goals, **the side-effects are called co-benefits.**

ORIGINS OF THE CLIMATE PREPAREDNESS ROADMAP

Following the devastation of the Marshall Fire, the Polis/Primavera administration and the state legislature recognized the need to focus proactively on climate preparedness and adaptation, in addition to disaster recovery. As the adage goes, an ounce of prevention is worth a pound of cure. The need to fulfill this role was realized even as far back as 2011, through the then Climate Preparedness Project. That report identified a need for a "climate adaptation organizer" to "facilitate communication and interagency efforts across the state." Research for this roadmap confirmed the need for that central role and identified a clear need for the state to:

- Build a shared conception of climate adaptation and unite actors around shared goals.
- Build continuous alignment with the Governor's Office and key actors in climate preparedness.
- Streamline cross-agency and cross-sector collaborations to ensure policy coherence. Design intelligent incentives for compliance.
- Assist in filling service and knowledge gaps.

Senate Bill 22-206, which included numerous Marshall Fire and broader disaster recovery efforts, helped realize this longer-term vision and represented a significant step forward in Colorado's preparedness and recovery resources. Among these initiatives was the creation of the Office of Climate Preparedness and Disaster Recovery (CPO) within the Governor's Office.

The CPO is closely coordinated with the Colorado Resiliency Office (CRO) within DOLA, providing leadership and capacity across an array of resilience issues, and especially as a key resource for local governments. In the wake of the 2012 wildfires and 2013 flooding events, the Colorado Resiliency Office was established to better address future shock events and stressors to protect lives, property, and livelihoods. The CPO is also closely coordinated with the broader hazard mitigation efforts of the Division of Homeland Security and Emergency Management and the broader recovery efforts of the Colorado Department of Public Safety and Department of Local Affairs. With the growing partnerships across state agencies, added agency staff and other positions' increased focused on adaptation efforts, the state is quickly increasing its capacity and coordination on climate adaptation.

Creating the Office of Climate Preparedness within the Governor's Office also represented a unique approach aimed at coordinating adaptation expertise across agencies, while also being naturally suited to provide a 30,000-foot view to support coordination and prioritization. The CPO's spot in the Governor's Office also provides a natural engagement point into the annual legislative and budget development processes, contacts with the congressional delegation and federal administration, and other functions common to the Governor's Office. The Marshall Fire reminded Coloradans that the frequency and severity of disasters is increasing. It also made plain the need for more disaster recovery capacity within the Governor's Office.

SB22-206 further tasked the CPO with producing a Climate Preparedness Roadmap every three years to set a path forward for Colorado's journey in adapting to the climate crisis we face. This report is the state's first Climate Preparedness Roadmap.

Roadmap Background

The state has produced a breadth of climate analysis and planning over the past 15 years (See Figure 1). Much of this work lays out valuable broader needs and goals for greenhouse gas mitigation, sustainability, and resilience.

With the Climate Preparedness Roadmap, the state seeks to build on its past work by focusing more directly on climate adaptation understandings and actionable steps. Using the best available science and data, the roadmap seeks to better prioritize near-term actions and develop actionable and achievable next steps. Prioritization is a critical exercise to attempt, because a significant challenge with climate adaptation is that the scope of its known and hypothetical impacts and actions could include nearly anything.

The CPO and the Climate Preparedness Roadmap have also worked to maintain close coordination and consistency amongst state partners and related planning efforts. In certain instances to avoid any duplication, the Climate Preparedness Roadmap serves not as an independent plan, but as a point of reference for coordination or prioritization. For instance, the Climate Preparedness Roadmap is closely coordinated with the state's second Greenhouse Gas (GHG) Pollution Reduction Roadmap focusing on reducing the pollution that causes climate change through the deployment of clean technologies across all sectors of Colorado's economy. Furthermore, the Department of Homeland Security and Emergency Management (DHSEM) produced earlier this year the Enhanced State Hazard Mitigation Plan (E-SHMP), evaluating the full suite of hazards faced by state assets, which is coordinated with and helped inform this roadmap. These efforts are coordinated to guide state actions, while maintaining distinct areas of focus, analysis, and outcomes.

This roadmap will also serve more directly to inform and prioritize detailed climate adaptation considerations within the upcoming 2025 update to the Colorado Resiliency Framework produced by the Colorado Resiliency Office within the Department of Local Affairs. First produced in 2015 and updated in 2020,the Colorado Resiliency Framework includes a number of broader resilience priority areas, including understanding risks from natural and other hazards, addressing social inequities and unique community needs, and pursuing economic diversity and vibrancy in addition to climate resilience. The Colorado Resiliency Framework serves as the state's strategy to a more resilient future and lays out the state's resiliency vision and goals.

Climate Preparedness Roadmap Development

This roadmap was produced with several goals in mind consistent with SB22-206, and was developed through several phases to meet those goals:

First, in creating the roadmap the state seeks to **not reinvent the wheel, but to build off work and analysis already done by the state**. In the first phase of developing this roadmap, the CPO worked with research think tank DemosHelsinki to catalog as many past and existing state programs, activities, reports, and recommendations as possible to support a better understanding of existing activities. The CPO also reached out to a wide array of external stakeholders, members of the public, and academic experts to inform this evaluation. Other state agencies have already used this cataloging work to avoid duplicating efforts.

This roadmap aims to create as **broad an understanding as possible of the future impacts of climate change in Colorado.** This means starting with the best available science and adding layers of analysis regarding population and demographic projections, natural systems and ecological data, and equity and disproportionately impacted communities. This was accomplished through a Climate Risk Assessment paired with extensive internal and external collaborations.

This roadmap seeks to **identify initial gaps and opportunities and to better prioritize state actions in climate adaptation** by better understanding the likely future conditions and needs and comparing those with what the state is already doing. It also means staying true to Colorado's greenhouse gas reduction targets. This occurred through numerous conversations and several workshops with state agencies. The office then collaborated with Colorado Health Institute (CHI)'s Acclimate Colorado team to map strategies with gaps and opportunities. CHI's team led a crosswalk analysis of materials from several phases of the roadmap development to help produce this first-of-its-kind roadmap for Colorado.

This roadmap seeks to **advance actionable and achievable next steps for the state government to take in the near term** as it embarks on this climate adaptation focused work. Progress on adaptation is critical to securing a vibrant and resilient future for Colorado. Identifying broader considerations or aspirational needs and goals has value. However, this roadmap places a focus on actionable and achievable next steps to better ensure progress and accountability in achieving needed climate adaptation outcomes. The roadmap's action items have been developed alongside state agencies in an effort to largely identify actions that can be achieved regardless of external factors. The roadmap will be updated every three years to reflect updated analyses and next step actions. This helps ensure continued progress on climate adaptation.

Given the large scope of issues climate adaptation could encompass, some areas are not included within this roadmap, and they are acknowledged throughout the report. Furthermore, while the Climate Preparedness Roadmap will be updated once every three years, consistent with SB22-206, the CPO's work will be iterative, supporting the continued advancement of the understanding of Colorado's climate future and the opportunities to improve it.

A Roadmap Informed by Coloradans

During the development of this roadmap, the CPO engaged with hundreds of diverse stakeholders from across the state. These engagements included three early focus groups and an academic expert focus group to understand public and expert perceptions of state climate adaptation actions and needs. In addition, CPO hosted a dozen stakeholder meetings and 13 geographically diverse public listening sessions including with translation available. Feedback mechanisms included facilitated discussions, in-person and remote meetings, and asynchronous surveys, engaging over 100 organizations and 250 individuals statewide. The inclusive approach involved perspectives from various communities, including urban, rural, mountain, Eastern Plains, Western Slope, environmental, public health, nonprofit, government, labor, industry, and agriculture among others. Particular consideration was made to engage with community leaders and individuals with lived experience from vulnerable and disproportionately impacted communities, including with language accessibility and stipends. The CPO also held numerous one-on-one meetings with stakeholders and experts. Analysis and recommendations were developed in consultation with Colorado agency leadership and subject matter experts through numerous direct meetings and workshops, as well as incorporating data from the Colorado Climate Center, State Demographer's Office, and CDPHE Environmental Justice program. These efforts were made to inform the identification of needs, priorities, opportunities and potential actions. It is worth noting that actions or recommendations will also go through any regular processes for community engagement upon implementation or further consideration. See Appendix D for more detail.

13 Public listening sessions

12 Sector-specific stakeholder group meetings

100+ Community organizations engaged

250+ Coloradans across many communities involved statewide

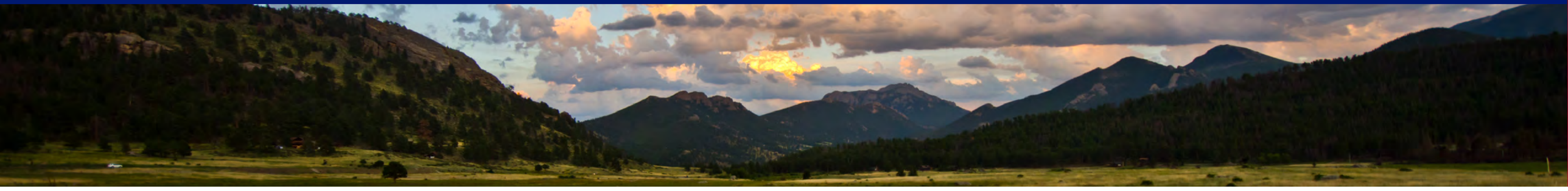


Figure 1. The State of Colorado Has Developed a Breadth of Climate Impact Knowledge Over the Last 15+ Years

2009 — Colorado launches its Climate Preparedness Project to assist it in understanding its key climate change vulnerabilities

2013 — Colorado develops its Drought Mitigation and Response Plan to provide effective and systematic means to reduce impacts of water shortages over both the short and long term

2014 — Colorado Climate Change Vulnerability Study identifies key vulnerabilities that climate change and climate variability will pose for the state's economy

2015 — Climate Change in Colorado report published to synthesize climate science relevant for management and planning of the state's water resources

2015 — Colorado Climate Plan shared to promote state-level policy recommendations and actions to strengthen the state's capacity to adapt to future climate change impacts and reinforce state agencies preparedness, while highlighting opportunities to mitigate GHG emissions

2020 — Colorado Community Perspectives on Climate Change documents different communities' concerns about climate change and their thoughts on the state's efforts to reduce GHG emissions

2020 — First publication of the state's GHG Pollution Reduction Roadmap, laying out an achievable pathway to meet the state's science-based targets

2022 — Colorado Counties Health and Climate Index updated report to illuminate how environmental exposures, demographics, and local policies and perceptions can affect vulnerability to climate change impacts

2023 — Colorado Water Plan is published as part of a grassroots effort to provide a framework for helping the state meet its water challenges via collaborative action around water development and water conservation

Colorado's history of key climate-related reports — featured reports

2009 — Colorado Climate Preparedness Project

2012 — Joint Front Range Climate Change Vulnerability Study

2013 — Colorado Drought Mitigation and Response Plan

2014 — Climate Change in Colorado

2015 — Colorado Climate Plan

2015 — Colorado Climate Change Vulnerability Study

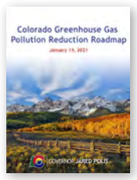
2016 — Colorado Local Resilience Project Report

2019 — Colorado River Availability Study Phase II

2019 — Reduction of GHG Pollution Bill (House Bill 19-1261)

2020 — Colorado Community Perspectives on Climate Change

2020 — Colorado Greenhouse Gas Pollution Reduction Roadmap



2020 — Future Avoided Cost Explorer (FACE)

2020 — Climate Resiliency Framework (Update from 2015)

2022 — Colorado Counties Health and Climate Index

2022 — Disaster Preparedness and Recovery Response Bill (Senate Bill 22-206)

2023 — Colorado Water Plan

Climate Change in Context in Colorado

Climate Risk Assessment and Climate Scenarios: An Aggregated Approach

Climate change is happening in Colorado and across the globe. As the state undertakes this focused work to adapt to climate change, it's important to understand the challenges within a Colorado-specific context. The state's high elevation, topography, low humidity, and other natural factors influence how our state, natural systems, and people will experience the impacts of climate change. Population, demographic, and socioeconomic trends specific to Colorado also influence how climate change affects us and how we adapt. These factors must inform the state's adaptation thinking and policy interventions. For example, the strong effects of the sun and low humidity in Colorado mean very different potential solutions for Colorado than, for example, a Gulf Coast state. An important step for the state and the CPO is to advance understanding of how climate change will play out in Colorado given these nuances.

While it is impossible to perfectly predict the future, it remains important to seek out the best scientific estimates and most interconnected understanding possible. For this roadmap, the CPO conducted a scenario-based Climate Risk Assessment, built on climate science and data which drew on multiple sources, including physical climate and socioeconomic scenario analysis from McKinsey & Company and expertise at the State Demographer's Office, Colorado Department of Public Health and Environment's (CDPHE) Environmental Justice program, and others.* This analysis leveraged downscaled global climate modeling to create scenario analyses of climate hazards relevant to the State of Colorado and tailored to its unique geographical, climatological, and socioeconomic contexts (see Appendix B for additional information on the Climate Risk Assessment approach). The foundation of the analysis is the tailored climate hazard scenarios. The results of this analysis are broadly consistent with the findings in the Colorado Climate Center's forthcoming 2023 Climate Change in Colorado report, which focuses on scenarios that most closely align with current policy expectations. Atop this foundation are layers of population and demographic projections, socioeconomic projections, vulnerable communities considerations, and natural systems considerations. This multi-tiered approach helps entities better understand and triage the most likely climate scenarios and climate risks (See Figure 2).

* The State of Colorado is responsible for the conclusions and recommendations of this report.

Figure 2: Climate Risk Assessment: Calculating Climate Risk, Limitations of Assessment

Approach for This Assessment:

Exposure

- Employ downscaled global climate models and other best-available science to calculate relevant climate hazard metrics.
- Assess hazards at 522 grid cells across Colorado.
- Evaluate three warming levels: 1.1 degree C (today), 1.5 degree C, and 2 degree C of global warming above pre-industrial (1850-1900) conditions.

Vulnerability

- Qualitatively assess Colorado's vulnerability, based on understanding of the state's people, communities, economy, built environment, and natural systems.
- Quantitatively use damage functions to calculate relative risk, where applicable (e.g. flooding).

Limitations of Risk Assessment:

Climate risk assessments do have limitations, which must be acknowledged and addressed.

- Models do not always have a full view of how the human-constructed world works.
- Models do not typically account for implemented adaptation measures.
- Damage functions are often high-level estimates and do not account for site-level details.
- Nonlinearity of climate impacts may cause some risks to be under or over estimated.

This process also incorporated CDPHE's Colorado EnviroScreen tool to enhance understanding of climate change science and data, with a focus on disproportionately impacted communities. Additionally, The Nature Conservancy's Resilient and Connected Landscapes framework was also referenced alongside other existing state resources to gain a more comprehensive understanding of climate science within the context of natural systems.

In seeking to narrow an impossibly large scope, these analyses help prioritize actions to meet the specific needs of Colorado's specific circumstances. The analyses provide insights into what the new normal will be given climate change, showing what the average conditions will be under given scenarios. Just as we have extremes today that far exceed our average conditions, the extremes in the future are expected to exceed these projections. Before examining the hazards that climate change presents to Colorado, it is important to understand the context of Colorado's temperature, precipitation, unique topography and elevation and how that affects local climate, as well as projections for Colorado's future population and economic growth.

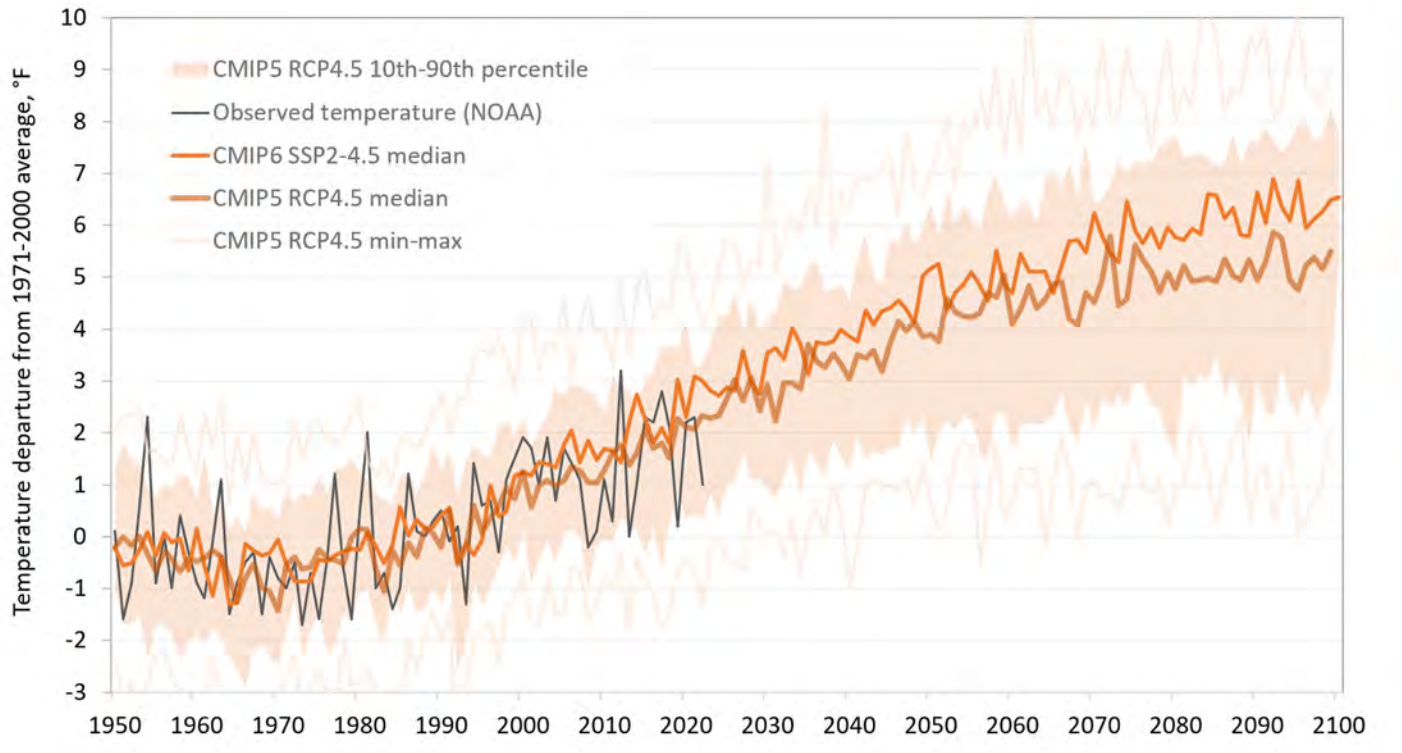
Colorado's Climate: Temperature is Rising, Precipitation Varies

Colorado experienced seven of its nine warmest years on record since 2012, according to the forthcoming 2023 Climate Change in Colorado report from the Colorado Climate Center. The report notes with high confidence that the state will see temperatures rise 1 degree F to 4 degree F from today to 2050, on top of the 2.9 degree F increase Colorado has already experienced since 1895.[11] Figure 3 from the Colorado Climate Center shows a consistent increase in temperature over the past century and projected increase through 2100 in a variety of emissions scenarios. (See Appendix A for more background on Figure 3)

Warming has already led to reductions in snowpack, soil moisture, and stream flows and has increased the frequency and intensity of extremes and hazards, including heat waves, droughts, and wildfires, with the expectation that these will worsen as temperatures continue to rise.[13]

Precipitation levels vary depending on location, time of year and elevation.[14] Colorado is the only state where every month is the wettest month on average somewhere. Precipitation has remained

Figure 3. Colorado Statewide Annual Temperature - Observed vs. Projected from 1950-2100 [12]



relatively steady on an annual basis, with some increases in the fall and decreases in the spring. Extreme precipitation events have become more intense in recent years and while projections are less certain for this hazard, they are projected to become more frequent and intense throughout the 21st century.[15] Winter precipitation is likely to increase in the future, but more may fall as rain instead of snow, and mountains may not retain water as long in the spring.[16] Overall, future projections for precipitation show potentially lower annual precipitation rates, but this remains less certain.[17]

Colorado's Climate: Topography and Elevation Influences

Colorado's climate is strongly influenced by its central location in the continent, the high elevations of its diverse landscapes, and the intricate topographical features of its mountains, plains, and plateaus. These topographical characteristics play a significant role in shaping the weather and climate patterns, leading to considerable climatic variations over short distances. Whether in the mountains, plains, or anywhere in between, topography and elevation have an influence on local climate.

The interplay of elevation, mountain ranges, valleys, and prevailing wind patterns directly impacts factors such as wind, humidity, temperature fluctuations, and precipitation distribution.[18] Colorado's central position results in frequent sunshine, low humidity, and substantial daily and annual temperature variations. These are magnified by Colorado's high elevation. The state's distance from major moisture sources — namely the Pacific Ocean and the Gulf of Mexico — results in reduced precipitation for lower elevation areas. Conversely, the high mountain ranges benefit from the moisture coming eastward from the Pacific during winter.[19]

Elevation plays a crucial role in temperature patterns as well. In general, temperatures drop as altitude increases. Areas over 10,000 feet experience single-digit or subzero temperatures in winter and highs in the 60s and 70s in summer.[20] In contrast, lower elevation regions and the plains (typically around 5,000 feet or lower) witness winter temperatures in the teens and often see hot summer temperatures exceeding 90 degrees.[21] Middle elevation areas offer warm summer temperatures, though rarely reaching the 90s, while winter months bring frequent single-digit temperatures. Extremes span from subzero temperatures, with winter readings plummeting below minus 40 degrees in the high mountain valleys, to triple-digit highs exceeding 110 degrees in the lower valleys of the Eastern Plains.[22] Lamar set Colorado's record high of 115 degrees in 2019.[23] The state's high elevation also drastically increases the effects of direct sun, with the strength of the sun at Colorado's high elevation and thin atmosphere being a significant factor in how Colorado experiences heat. The influence of shade or north vs. south facing slope aspect has a significant impact on microclimate temperatures.

In general, absolute heat impacts correlate in magnitude with lower-elevation areas, such as the Eastern Plains and parts of the Western Slope, and select other areas where localized factors play a meaningful role. In some areas of the state, increases in extreme cold snaps pose some increased risk, however, portions of eastern Colorado are likely to see a meaningful convergence of increasing risks (See Figure 4).

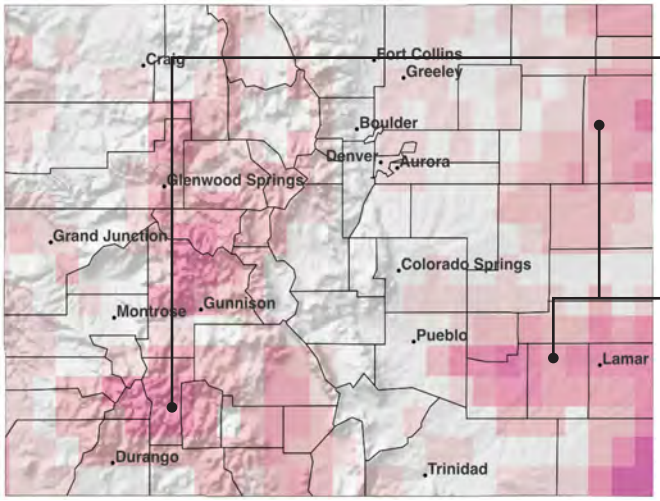
Topography also affects precipitation. Precipitation levels typically increase with elevation across all seasons, particularly in winter when the majority of moisture falls as snow. The seasonal distribution of precipitation is heavily influenced by geographic location.

Precipitation patterns across Colorado exhibit seasonal variations. Generally, the Eastern Plains receive more rainfall during the spring and summer months, with peaks in May for northeast Colorado and July for southeast Colorado. The mountains tend to be wetter in the winter and early spring, while southwest Colorado gets its highest precipitation levels during the North American Monsoon in August and September. Annual precipitation totals vary significantly, ranging from less than 10 inches in the San Luis Valley to more than 40 inches in high mountain ranges, occasionally even doubling that amount.[26] Adaptation planners should work to understand Colorado's current and future interplay of temperature, precipitation, and regional variation by topography and elevation.

Figure 4. Eastern Colorado Faces Heightened Climate Hazard Exposure to Extreme Heat, Fire, and Water Scarcity [24,25]

Number of hazards above high exposure thresholds

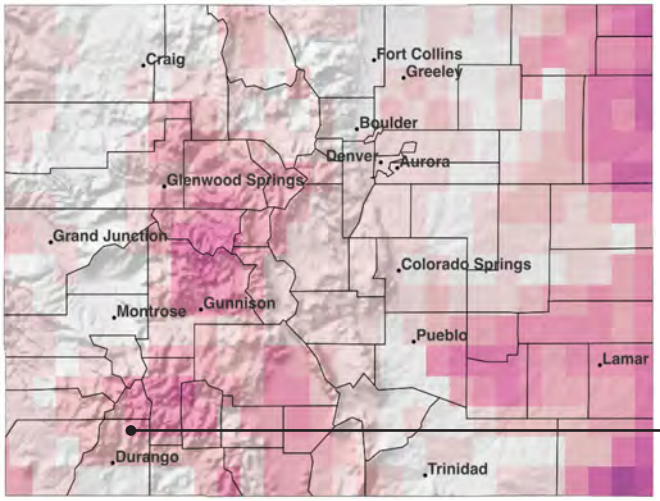
Today (1.1°C)



Exposure over Rockies to precipitation and cold hazards

Exposure over southeast and northeast to heat, fire and water scarcity hazards

Change to 1.5°C

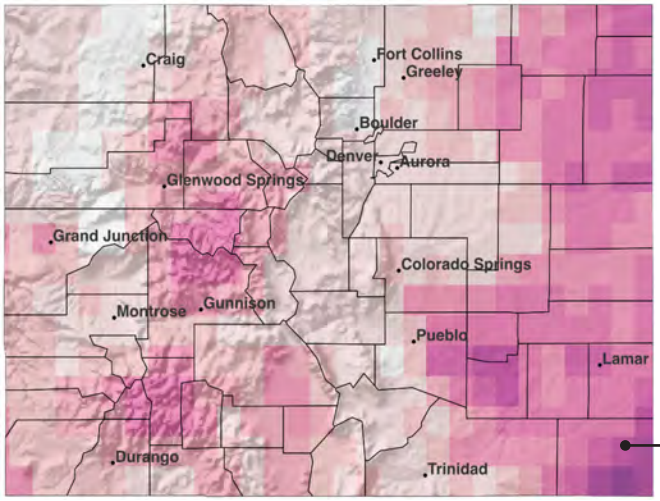


Small increases in the number of cold/ precipitation hazards under climate change over the Rockies are not likely to be highly impactful; instead, some reductions in snowfall could potentially pose threats to the ski industry

Number of Hazards

0 9

Change to 2°C



Large increase in the area of eastern Colorado facing heat, fire and water scarcity-related hazards is likely of most concern to people and key industries (e.g., agriculture and utilities)

Note: High exposure thresholds are based on the 90th percentile of the hazard distribution across the state in the 1.1°C scenario.

Socioeconomic Considerations

Colorado's Population and Economy are Likely to Grow, Primarily in Urban Centers

The State Demography Office (SDO) estimates that Colorado will add 1.72 million people by 2050, bringing the population to nearly 7.5 million.[28] The population is on track to grow older, leading to a potential imbalance between the wage-earning workers and retirees. Job growth plus an increase in retirements due to aging is creating demand for migration to the state. Additionally, it is important to note that Colorado is forecast to grow at a slower rate the next 30 years compared with the last 30 years due to slowing births and increasing deaths in Colorado and the U.S. as a whole. We are also seeing lower levels of net migration and increased competition for workers in the state. (The analysis from the SDO does not include projections related to climate change.) These estimates are just that and can shift with changes in many factors. In general however, likely trends of a growing population along the Front Range, increases of population in the wildland urban interface, and the trend of an aging population are valuable considerations when thinking about future climate change impacts to the state.

Shared Socioeconomic Pathways (SSP) models do factor in projections related to climate change. Overall, in the climate risk assessment, both SSP scenarios suggest an increase in population by 2050, with a trend of migration toward urban centers, primarily the Front Range, which increases the potential for exposure to climate hazards for more of the population. Both scenarios also anticipate steady economic growth in terms of GDP, mostly centered in those urban areas.

See Appendix C for details on the SSP projections, including maps.

While both SSP analyses suggest most population growth will occur along the Front Range, relative populations in the wildland urban interface (WUI) have also increased, as has what areas are considered within the WUI.[29] Population growth pressures along the Front Range and elsewhere have impacts on climate resiliency and natural systems. From 1982 to 2017, Colorado lost over 25% of its farmland, with growth in urban areas growing fastest.[30] From 2001 to 2019, the developed area in the Denver region increased by 22%, and if this growth trend continues, it could potentially expand by an additional 41% by 2050.[31]

These trends, along with projected scenarios, illustrate shifts in population characteristics, economic growth, and population distribution that are valuable to take into account for climate resilience strategies.

Shared Socioeconomic Pathways Scenarios

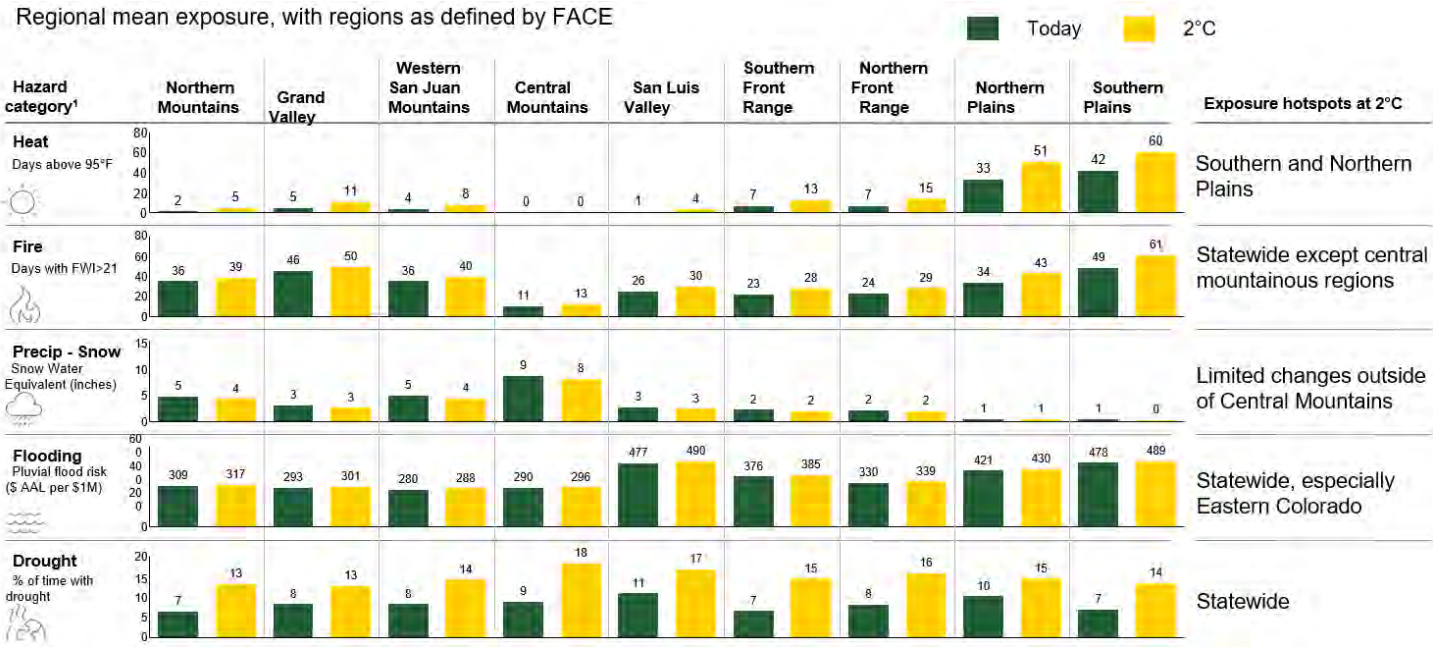
For this roadmap, the Climate Risk Assessment used the Shared Socioeconomic Pathways (SSPs) scenarios to better understand impacts on population, demographic, and economic trends. SSPs are a set of five scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) to explore how different socioeconomic and demographic factors may influence future climate change.

The analyses developed to support the Colorado Climate Preparedness Roadmap included population and GDP projections reflecting 2020 data for counties in Colorado with U.S.-specific projections based on the SSPs estimates for SSP2 and SSP3. SSP2 reflects a middle-of-the-road socioeconomic projection scenario that largely mirrors business-as-usual growth out to 2030 and 2050. SSP3 reflects a less optimistic scenario that assumes comparatively lower levels of growth by 2030 and 2050.[27] See Appendix C for additional information.

Key Climate Hazards

Bringing together numerous factors within the climate risk assessment, it's clear that several hazards pose outsized risks for Colorado as the climate warms. This section focuses on hazards and climate change's influence on them. It represents a snapshot of the hazards drawn from numerous other state sources. A more exhaustive list of hazards were evaluated through the Division of Homeland Security and Emergency Management's Enhanced-State Hazard Mitigation Plan (2023), which looks at current hazards across Colorado (regardless of susceptibility to climate change) and defines the state's strategy for hazard mitigation — actions to reduce or eliminate long-term risk to people and property from future disasters. The hazards included in this roadmap are highly influenced by climate change and, when also viewed through population and demographic, socioeconomic, and geography lenses, are areas the state will need to prioritize as it works to adapt to climate change.

Figure 5. Colorado Faces Increasing Heat, Fire, and Drought Exposure, Decreases in Snowfall, and Similar Flood Risk in 2 Degree C Scenario [32]



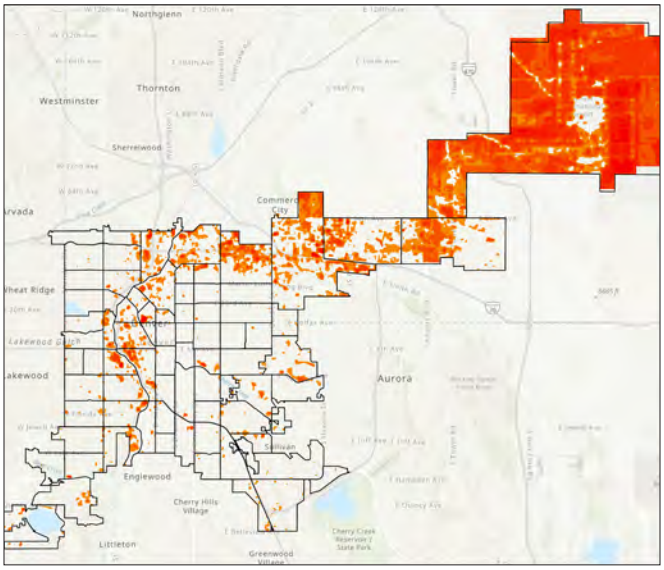
Extreme Heat and Warming Temperatures

Current State

The most fundamental and pervasive effect of human-caused climate change is the overall warming of the climate system.[34] Warmer temperatures drive downstream impacts, such as more severe drought, increased wildfire risk, more spring floods and erosion due to early snowmelt, damages to infrastructure from extreme heat, and harm to human health from greater heat exposure.[35]

Colorado continues to experience a meaningful warming trend. The fall season has seen the most warming, with a rise of about 3.1 degrees F.[36] The number of days with high temperatures of 95 degrees F or greater have been increasing over the past century, with current conditions rivaling the 1930s Dust Bowl era.[37] While the greatest annual warming has occurred in the Southwest and San Luis Valley, heat waves — periods of extreme heat — have increased in most areas of the state, with the biggest jump in the northwest and central Western Slope regions.[38] Additionally, warming temperatures have contributed to early snowmelt, and peak runoff has shifted one to four weeks earlier across Colorado's river basins over the past 30 years.[39]

Map 1. 78,000 People in Denver Live in Urban Heat Islands up to 9 Degrees F Hotter Than Surrounding Areas



Source: Trust for Public Land, Urban Heat Island Severity Map, 2019

Defining Domains at Risk

Climate change will impact hazard intensity and frequency, which will combine with additional elements that influence risk like social, population, economic and ecological factors. The resulting impacts are viewed as playing out in four key domains to help organize key conclusions. These domains include:

- **People and Communities**
  Communities and individuals in Colorado will experience the impacts of climate change, including direct impacts to health — some more than others. The population age 65 and up is expected to grow the fastest, and older adults have heightened health risks from climate change as do those already facing inequity in health or other systems.[33]

- **Natural Systems**
  Natural systems generally refers here to the entirety of living and non-living elements within ecosystems that are not human made. These systems have evolved and adapted to their habitats, but the pace and scale of climate change poses a significant threat to their functioning and ability to adapt.

- **Built Environment**
  The built environment refers to human-constructed buildings and infrastructure. Climate impacts manifest as direct damages to property and goods, operational downtime required to repair and recover damaged assets, and property value changes from direct and indirect climate impacts, such as wildfire damage or poor air quality.

- **Economic Sectors**
  Colorado's economy boasts a diverse mix of major industries, many of which are likely to experience various climate-related impacts. Compared to many interior western states, Colorado enjoys a strong and varied economy. The economic sectors included here are significant elements of Colorado's economy, which also faces heightened risk from climate impacts.

Cities are more likely to experience the urban heat island (UHI) effect — a phenomenon where built-up areas that lack green spaces are hotter. Approximately 78,000 Denverites experience the most extreme UHI effect, feeling a relative temperature 9 degrees fahrenheit hotter than surrounding areas.[40] In the future, though, extreme heat could affect Colorado's Eastern Plains the most, with up to 20 days on average exceeding 95 degrees F by 2050 in a 2 degree Celsius scenario.[41]

Extreme Heat and Warming Temperatures Projections

There is very high confidence that the climate of Colorado will continue to warm in all seasons through the mid-21st century.[42]

While the certainty of increasing temperature is clear, warming is most directly tied to emissions rather than time. However, by 2050, Colorado's average annual temperatures will likely match or exceed the very warmest years of the past, bringing large changes in the frequency and severity of heat waves.[44]

Heat waves are projected to increase rapidly statewide. In most regions, the median number of projected heat waves is expected to increase from one per year during 1971-2000 to approximately 10 per year by the 2060s.[45]

Extreme heat could affect Colorado's Eastern Plains the most, with approximately 20 more days exceeding 95 degrees F projected in a 2 degree Celsius scenario (see Figure 6).[46] These trends of increasing extreme heat have compounding risks that can exacerbate drought and wildfires and threaten our natural systems, built environment, and communities and people.

Climate Variable/ Event[43]	Recent Trend	Projected Future Change	Confidence in Change
Average Temperature	Warmer	Warmer	Very high

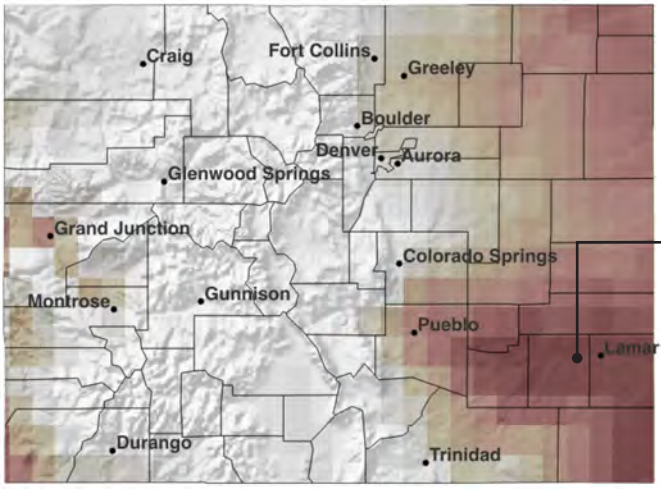
Examples of Impacts by Domain: Extreme Heat[48]	
Domain	**Impact**
People and Communities	Urban populations are projected to grow, potentially increasing exposure of people in these areas to heat-related hazards that can result in heat stress or illnesses.
Natural Systems	Higher temperatures will affect ecosystems statewide. Important habitats for native species and invasive species will shift in size and location. Higher temperatures will result in environmental changes such as warmer and shifted streamflows or changes in species reproduction cycles.
Built Environment	Extreme heat will likely affect Colorado's transportation, water, and energy infrastructure meaningfully. For example, heat exposure can increase cooling costs, damage concrete and railways, and impact water supply and quality.
Economic Sectors	Extreme heat is projected to affect key industries in Colorado. In the Eastern Plains, higher temperatures, fire, and water scarcity may result in economic losses of crops and livestock. In urban areas, the health care sector may be stressed from increased heat-related illnesses, and the utilities and manufacturing sectors will face challenges from the increasing demand for air conditioning. The outdoor and recreation industry may be affected by decreasing and shifting snow patterns and lower and warmer water supply impacting fisheries.

Figure 6. Extreme Heat Could Affect Colorado's Eastern Plains the Most[47]

Annual number of days with daily maximum temperatures exceeding 95°F

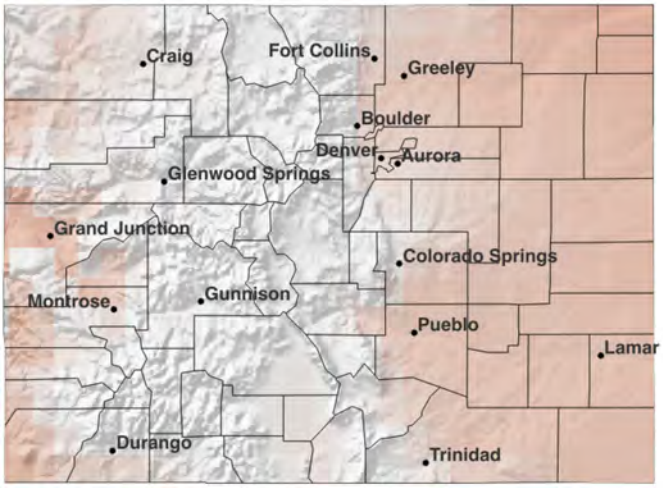
Number of Days
0 50

Today (1.1°C)



Southeastern CO is already exposed to extreme heat, with the highest recorded state temperature (115°F) occurring in 2019 in Bent County.

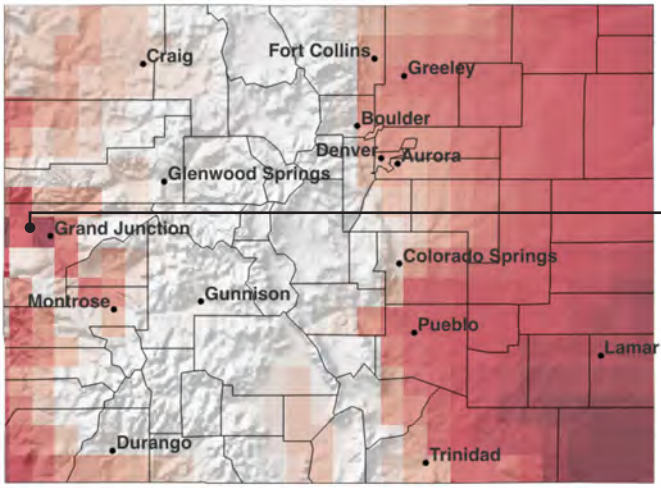
Change to 1.5°C



At 1.5°C warming, there could be up to ~9 more days per year exceeding 95°F.

Change in Number of Days
-20 0 20

Change to 2°C



At 2.0°C warming, up to ~20 more days per year could exceed 95°C both east and west of the Rockies, with eastern Colorado (especially Baca County) and the Grand Junction area most exposed.

Wildfire

Current State

Colorado has experienced more large wildfires in recent decades, in part driven by climate change. Wildfire risk is a complex puzzle that depends on a combination of weather, climate, topography, fuels and vegetation, and human activity, including human-caused ignitions. Wildfire burn scars also commonly lead to post-fire flooding and impacts to watersheds, which is addressed as its own hazard in this report to elevate the need for an increased focus on compound hazards.

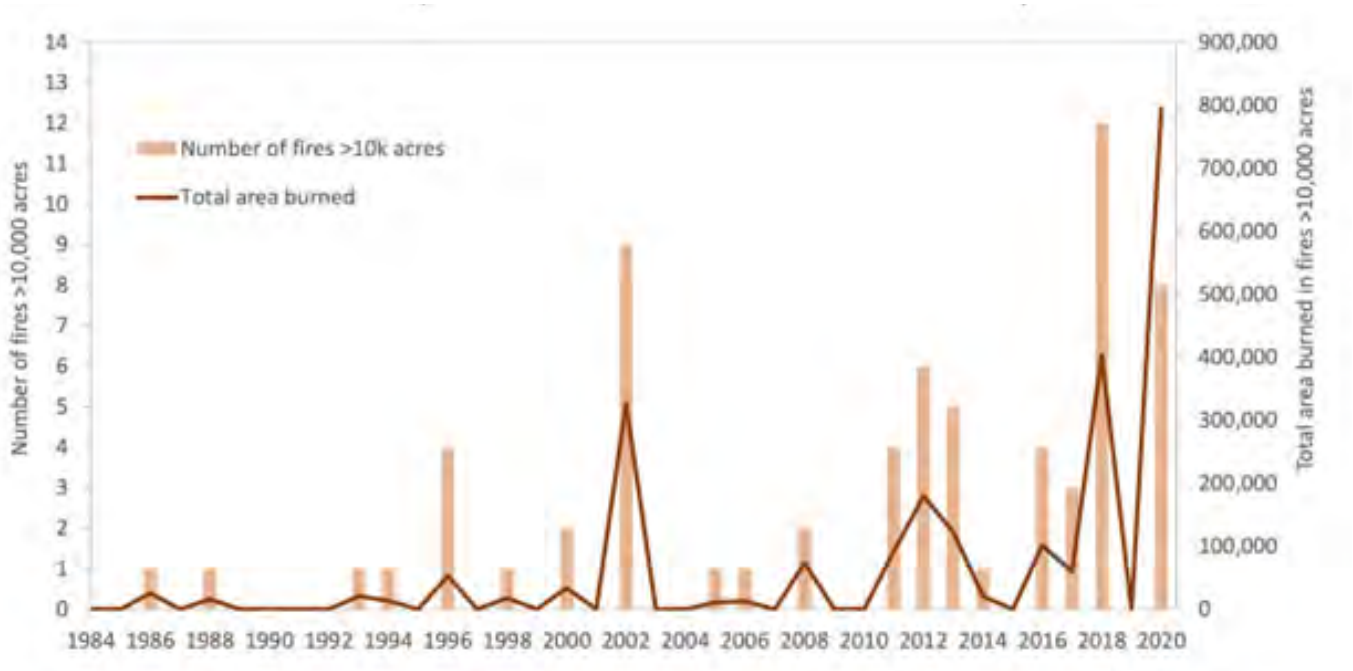
Warming temperatures dry out fuels, like trees and shrubs. Dry fuels allow fires to start easily, spread quickly, and burn more intensely.[51] Additionally, more rain in the spring can grow fuels, and less rain in the summer increases the risk of fires.[52] The Colorado State Forest Service's Wildfire Risk Assessment Tool provides information and analysis on potential wildfire risk across the state.

The occurrence and behavior of wildfires in the western U.S. are strongly influenced by weather, climate, and especially drought.[53] Colorado's 20 largest and most devastating wildfires have happened since 2001, with most occurring after 2016[54] (see Figure 7).

The wildfire season has expanded beyond May to September, posing a year-round threat.[56] Anecdotally, with snow cover coming later, Colorado has seen an increasingly common late-year fire season emerge, especially when a wet spring that increases vegetation growth is paired with a hot and dry fall, creating a higher volume of fuel on the landscape. Fall has also seen the highest rate of warming of any season.[57] When paired with a lack of high elevation snow cover, the combination can lead to unprecedented outcomes, such as when the East Troublesome fire jumped the Continental Divide in 2020.

Wildfires also contribute to air pollution. Wildfire smoke has immediate impacts on particulate matter air pollution, and indirect and less quantified impacts on other forms of air pollution. Federal regulations and standards don't yet fully account for these connections.[58] The projected increase in wildfires will contribute to more carbon emissions because forests are no longer holding onto the carbon they collect.[59] Colorado's Natural and Working Lands Strategic Plan for Climate-Smart Natural and Working Lands identifies strategies for stabilizing forest carbon on the landscape.[60]

Figure 7. Colorado Wildfires Over 10,000 Acres and Total Area Burned in Those Fires, 1984-2020 [55]



Wildfire Projections

Studies indicate that Colorado's wildfire risk will be significantly higher in the mid 21st century compared with the last few decades of the 20th century.[61] The annual amount of land area burned could increase between 100% and 500% by the mid 21st century.[62]

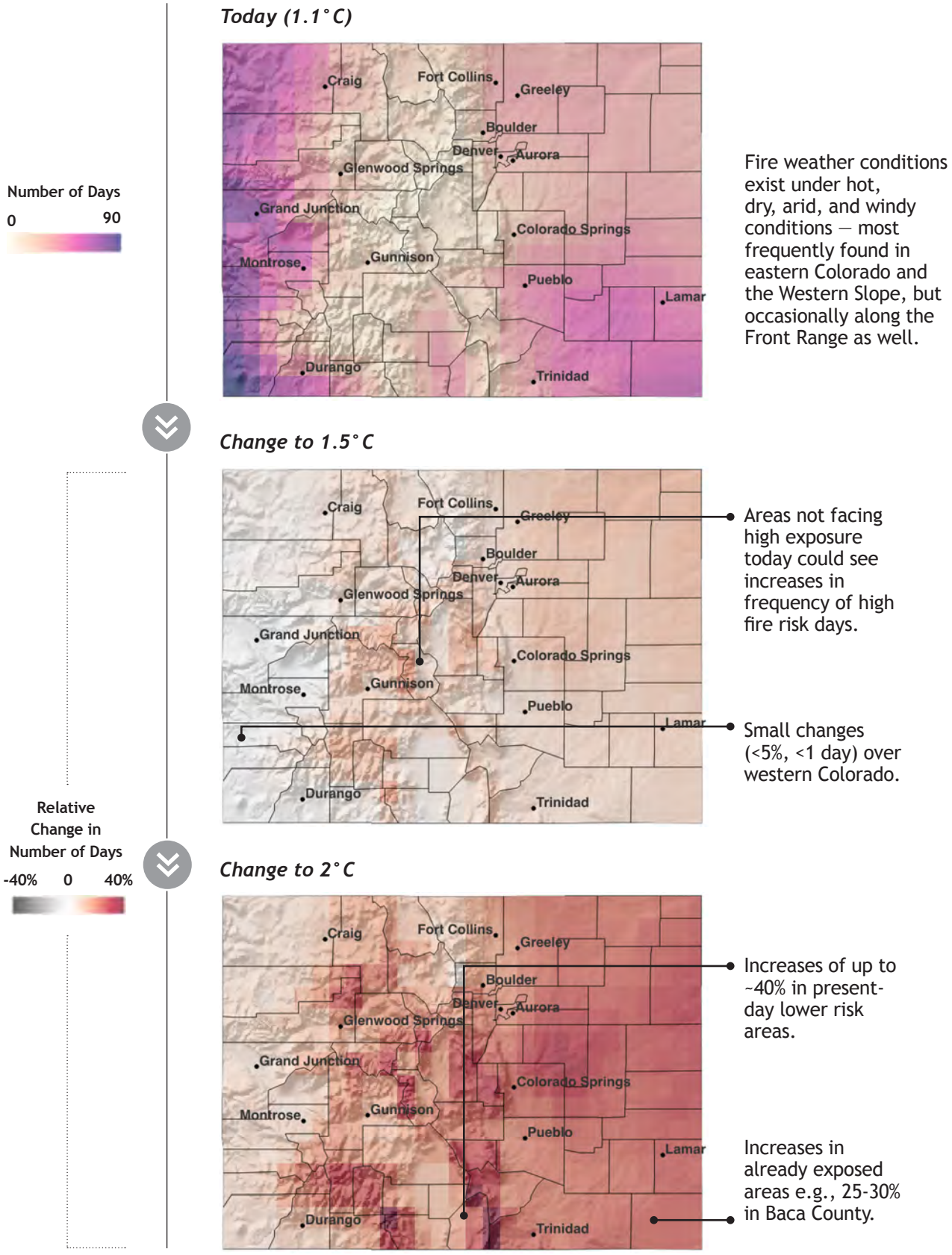
Hot, dry, and windy weather creates prime conditions for wildfires. These conditions will increase high-risk days for wildfires by 40%, including in some areas that are currently at lower risk[63] (see Figure 8).

Climate Variable/ Event[64]	Recent Trend	Projected Future Change	Confidence in Change
Wildfire Threat	Higher	Higher	High

Examples of Impacts by Domain: Wildfire	
Domain	**Impact**
People and Communities	Wildfires can have devastating impacts on communities and human health. As more Coloradans move into wildland urban interfaces — areas where structures and human developments intermingle with undeveloped land — there will be an increased risk of damage to homes and business and displacement of people.
Natural Systems	While wildfire is a natural part of many Colorado ecosystems, more frequent and intense wildfires can have impacts even in fire-adapted ecosystems. As the climate warms, wildfires may also drive the conversion of forest to non-forest in some regions.
Built Environment	Wildfires can damage buildings and critical infrastructure such as roads and power lines. Fire debris can damage waterways and reduce a community's access to clean water.
Economic Sectors	Colorado's 2020 wildfire season caused $16 billion in damages.[66] Wildfire smoke increases impacts to health and the health care system. Tourism attractions and manufacturing facilities can be destroyed during fires, and transportation can be disrupted.

Figure 8. Wildfire Is a Key Risk in Colorado[65]

Annual number of days with the Fire Weather Index (FWI)1 > 21, classified as "high risk" fire weather days



Note: These maps do not account for fuels or other factors that contribute to wildfires; they only focus on increases in fire weather days.

Drought and Precipitation

Current State

Colorado has been in varying states of drought since 2001.[67] While drought conditions have always been common in Colorado, warmer temperatures have created more severe drought in areas that might not be able to recover during wetter seasons.[68] Additionally, high temperatures could evaporate more water from reservoirs and reduce soil moisture, especially in summer months.

Drought has created diverse challenges across Colorado. Colorado's springtime snowpack and annual streamflows are lower than normal, reducing water availability and stream temperatures impacting the health of fisheries and aquatic ecosystems.[69] Snowpack and snow water equivalent have decreased over the past few decades, most notably in southern Colorado.[70]

Flash droughts — caused by a combination of high temperatures, low humidity, and high dry wind — have been occurring along the Eastern Plains. These droughts, which occurred in 2012 and 2020, primarily affect the agriculture industry because they are quick and intense.[71] Groundwater is a key water source for areas in the state, including areas of the Eastern Plains and San Luis Valley. In the San Luis Valley, there has been a depletion of 800,000 acre-feet of groundwater since 2002, which is unlikely to be replenished due to decreased streamflow in the Rio Grande River.[72]

Drought Projections

Drought frequency is likely to increase because precipitation patterns are unlikely to increase precipitation significantly over the next few decades while temperatures are predicted to climb, creating a drying effect that will continue to increase other hazards, such as wildfire and water stress.

Looking ahead, runoff is projected to come even earlier, meaning the mountains are retaining their water for shorter periods of time and less water will be available later in the year.[73] Additionally, more evaporation and less soil moisture in the summer is predicted to continue over the next few decades (see Figures 9 and 10).

Examples of Impacts by Domain: Drought and Precipitation[76]

Domain	Impact
People and Communities	Drought conditions can create water shortages for communities, which can have ripple effects on water treatment systems and access to clean water.
Natural Systems	Drier conditions and decreasing water supplies impact plant and animal habitat, increasing the susceptibility to disease and pests. Aquatic species may experience habitat changes as streamflows shift and stream temperatures increase with less water.
Built Environment	Drought conditions can damage water supply infrastructure, disrupting water storage and transport.
Economic Sectors	Many of Colorado's industries depend on consistent and quality water supplies and snowpack that are threatened by drought and competition for water resources.

Climate Variable/ Event	Recent Trend	Projected Future Change	Confidence in Change
Spring Snowpack	Lower	Lower	Medium
Runoff Timing	Earlier	Earlier	**High**
Annual Streamflow	Lower	Lower	Medium
Evaporative Demand	Higher	Higher	**Very High**
Summer Soil Moisture	Lower	Lower	**High**
Droughts	More frequent/ intense	More frequent/ intense	**High**

Figure 9. Water Stress, Increased Evaporation, and Demand[74]

Describes likelihood of annual water withdrawals exceeding water available from renewable surface and groundwater resources for a particular basin

This water risk assessment derived from global modeling is generally in line with more granular state-level modeling by the CWCB. Spanning five planning scenarios, CWCB finds that:

- The state currently faces an agricultural water gap, and this could increase statewide through reductions in water availability and increases in irrigation withdrawal
- New water gaps may emerge for municipal and industry needs through a growing population

Chronic
(demand exceeds supply ON AVERAGE)

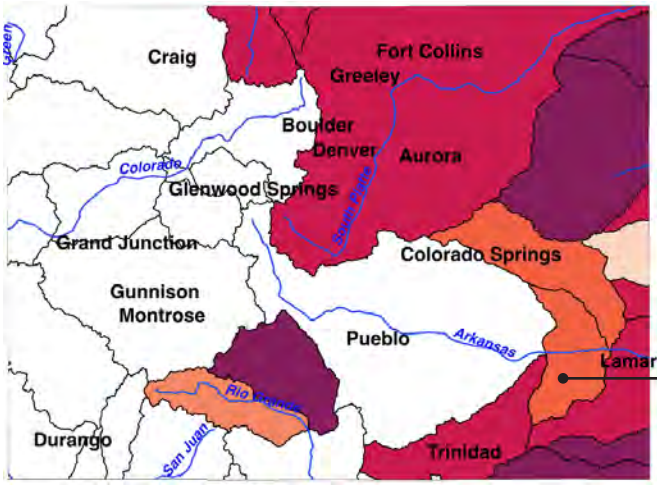
Frequent Shortage
(demand exceeds supply at least once per decade)

Infrequent Shortage
(demand exceeds supply at least once per 30 years)

Borderline
(increase in withdrawal or decrease in supply could result in water stress)

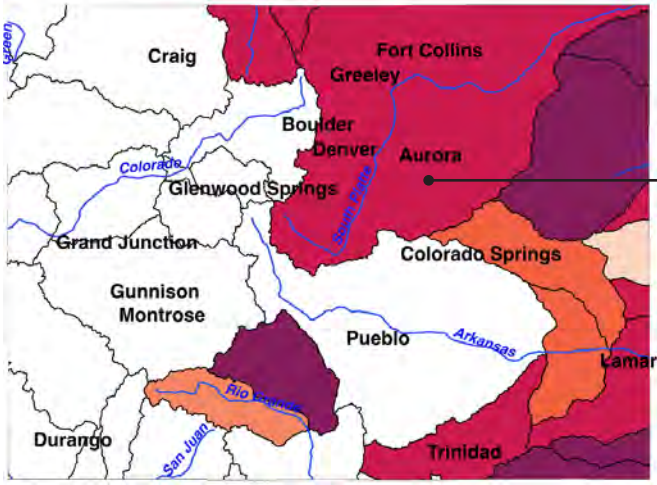
Low Demand
(excluded due to very low demand)

Baseline: 1986-2015



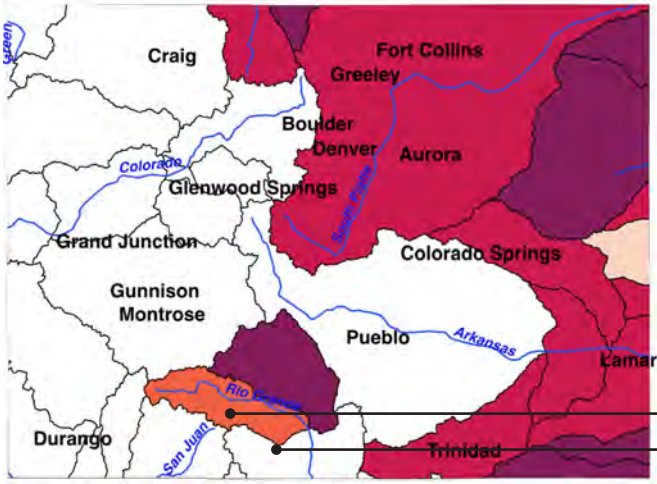
Eastern Colorado is typically very dry and relies on interbasin transfer across the Continental Divide to meet its water needs. For example, Denver receives ~54% water from interbasin transfer.

1.5°C



Most of eastern Colorado will not be chronically water stressed but could face bouts of water stressed years e.g., due to drought. The South Platte/Metro basin faces 10-20% water stressed years in all three scenarios.

2°C



Withdrawals due to irrigation are projected to increase across several eastern basins, while availability generally decreases (likely due to increased evaporation in a warmer climate).

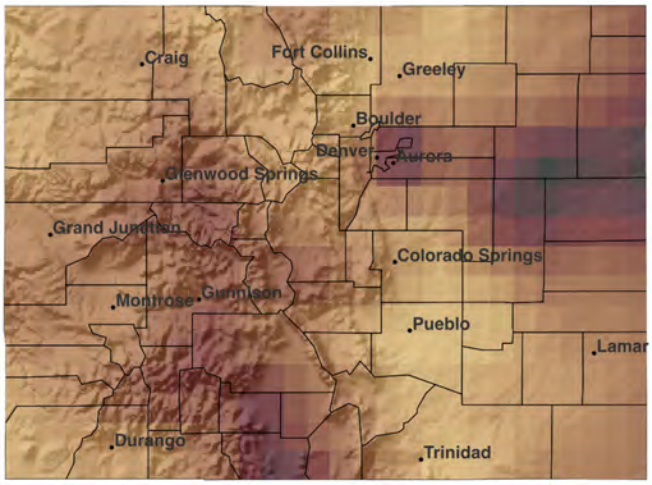
Figure 10. Drought Severity by Warming Scenarios[75]

Proportion of year in drought (%), as defined by the self-calibrated Palmer Drought Severity Index (PDSI)1

Drought (% of time)
0 14

Relative Change in Number of Days
-14% 0 14

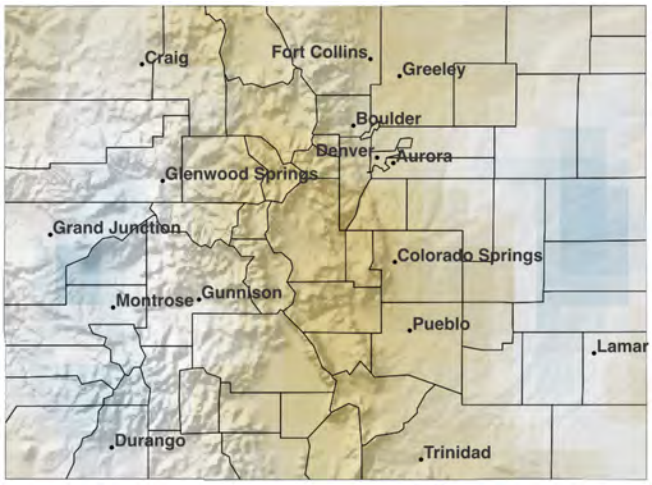
Today (1.1°C)



Colorado already experiences drought (often severely) across the state.

Drought in the Eastern Plains impacts agricultural production, while drought in the Western Slope affects water supplies across Colorado and other western states.

Change to 1.5°C



At 1.5°C warming, drought has mixed changes, driven by changes in precipitation amounts.

Given model noise, low confidence exists on how droughts may change in the near term.

Change to 2°C

However, at 2°C warming, drought frequency likely increases statewide, driven by warming temperatures.

Compound Hazard: Post-fire Flooding

Current State

Compound hazards, particularly post-fire flooding, is an area that needs more research and specific focus, but one which we anecdotally know is a significant hazard and which has played out frequently in Colorado. Wildfires create conditions for another natural hazard — flooding. Large and more frequent wildfires are leaving the land more susceptible to pluvial flooding — also known as flash floods and surface-level floods. The aftermath of wildfires poses a heightened risk of flooding due to the impact on soil vegetation. When vegetation is burned, the soil's water absorption capacity is diminished, which raises the potential for floods. The presence of vegetation plays a crucial role in structuring soil, influencing its ability to retain moisture. It is noteworthy that soil moisture levels significantly affect this process, with extremes such as excessive dryness or saturation contributing to increased flooding risks.[77]

Burn scars — areas of land that have been burned and are susceptible to erosion — are notorious for debris flows and flash floods, especially during heavy rainfall.[78] Burn scars from high-intensity fires can have long-lasting ecological and environmental impacts, affecting the landscape and local ecosystems. Flash floods and debris flows can develop in recently burned areas with much less rainfall than would be needed in non-burned areas.[79] After Colorado experienced burn scar flash flooding in 2002, 2012, and 2018, concerns grew significantly following the unprecedented 2020 fire season, which burned a record 625,000 acres. An example of this is the Grizzly Creek Fire burn scar, which resulted in major mudslides and flooding impacting Glenwood Canyon caused by record rains in July 2021.[80] Flash floods and debris flows from the Cameron Peak Fire burn scar caused loss of life and property in both 2021 and 2022.

Post-fire Flooding Projections

Since post-fire flooding impacts are modeled primarily on wildfire and pluvial flooding models, more research and hazard-specific modeling is needed to fully understand its current and projected impact in Colorado. This hazard represents a composite of variables within wildfire, drought, flood and extreme precipitation hazards that should continue to be understood together. It is an area that is not well accounted for in federal recovery systems or policies. Colorado has sought to break down these silos and better account for this risk through the DHSEM Colorado Post-Wildfire Guide. The state has also invested heavily in

Examples of Impacts by Domain: Post-fire Flooding[83]

Domain	Impact
People and Communities	Burn scar associated floods, mudslides and debris flows have led to loss of life and can damage homes and communities that are near or below burn scars. Water quality and supply for even far downstream communities can be threatened.
Natural Systems	The intensity and speed of post-fire floods can damage forests, aquatic ecosystems and water quality, alter soil properties, and push excess debris into streams.
Built Environment	Roads, bridges and water infrastructure can be damaged by post-fire floods, reducing access to communities, threatening clean drinking water supply, and requiring costly emergency repairs.
Economic Sectors	Areas affected by or at risk of post-fire flooding may experience a drop in tourism and recreation.

mitigation efforts on burn scars to avoid this risk, but with federal policy not fully accounting for this risk and most burn scar acres on federal land, efficient mitigation of this risk remains a challenge.[81]

The area burned by wildfires in Colorado has increased in the 21st century and is expected to rise further in a warming climate.[82]

The growth of burn scars raises the risk of flooding during intense thunderstorms. If intense storms also increase, the frequency and intensity of compound flood-after-fire hazards will rise significantly.

Flooding and Extreme Precipitation

Projection models have less confidence for extreme precipitation and flooding projections for Colorado compared with other hazards.

Current State

- **Extreme Precipitation**[84]

Precipitation during the warm season (April-September) usually falls as rain or hail, leading to flooding risk, and when severe, significant hail damage. During the cold season (October-March), precipitation generally falls as snow at all elevations, but heavy rainfall and flooding risk can occur at lower elevations (6,000 feet and below).

Eastern and western Colorado experience varying degrees of heavy and extreme precipitation events. Eastern Colorado is more prone to strong storms with lightning, while the Western Slope has larger rainfall events. Hail is a significant risk for Coloradans, with Colorado's Front Range in the heart of "Hail Alley." Residents can expect three to four catastrophic events per year (defined as over $25 million in insured damage), with more than $5 billion in insured damage over the last 10 years.[85]

Extreme rainfall trends are mixed, meaning some data collection indicates that recent extreme rainfall events have increased, while other models don't reflect those findings. Recent trends for severe thunderstorms are uncertain — possibly occurring more frequently in the future — however the confidence in this trend is low.[86]

Climate Variable/ Event[93]	Recent Trend	Projected Future Change	Confidence in Change
Flooding Risk	Mixed	Higher	Medium
Extreme Precipitation	Higher	More Frequent/ Intense	Medium
Severe Thunderstorms	Uncertain	Possibly More Frequent	Low

- **Flooding**

Flooding risk is composed of complex factors including precipitation levels, urban development, soil texture, soil moisture, and an area's topography and vegetation. Most floods occur in Colorado's warmer months (April-September) when large storms are more frequent.[87]

On the Western Slope, flooding also occurs from the melting of unusually large snowpacks, which typically arise from multiple heavy snowstorms.

While large destructive floods, like the 2013 Front Range Flood, have occurred in recent years, Colorado's flood patterns have not changed much in recent decades.

Periods of exceptional drought and wildfire can increase flood risk over the shorter term, through burn scars and drier soils.[88]

Pluvial flooding includes flash floods and surface floods, and is a critical hazard for Colorado, especially in eastern Colorado. Fluvial floods are river-based floods, which pose a smaller risk to Colorado relative to pluvial floods. However, fluvial floods can still bring damage on major rivers in populated areas, such as the South Platte.[89]

Projected Impacts

Projection models are less confident about extreme precipitation and flooding compared with other hazards. In general, a warmer atmosphere means more energy and more intensity, but many other factors play a role, especially in Colorado. Models show medium confidence that extreme precipitation will be more frequent and intense in the future.[90] Increases in yearly average one-day accumulated precipitation amounts are greater over the Northern Rockies (see Figure 11). Considered in isolation, projected increases in extreme precipitation would lead to increased frequency and severity of flooding; however, projected declines in summer soil moisture could be a countervailing factor.[91]

There is medium confidence that flooding risk will be higher in the future. Pluvial flooding will remain a hazard of concern for Colorado with small increases in risk (see Figure 12). Fluvial flood risk could further decrease slightly in the future.[92] Overall, more research will continue to be needed to better understand and model future impacts from flood and extreme precipitation.

Examples of Impacts by Domain: Flooding and Extreme Precipitation[96]

Domain	Impact
People and Communities	Floods can displace families. Extreme rain and flooding can cause water quality issues.
Natural Systems	Flooding causes soil erosion, a depletion of soil nutrients and can damage wildlife habitat and cause damage to vegetation root systems.
Built Environment	Extreme rain and flooding can damage transportation infrastructure by eroding materials or washing away roads and bridges. Buildings and facilities are at risk of water damage, which can be costly to remove and repair, especially for properties without flood insurance. Flooding in Colorado can also shift sediment and waterway boundaries impacting development patterns as happened in 2013.
Economic Sectors	Heavy rainfall and floods can impact many sectors through facility closures, disruptions in operations and supply chains, and damage to infrastructure.

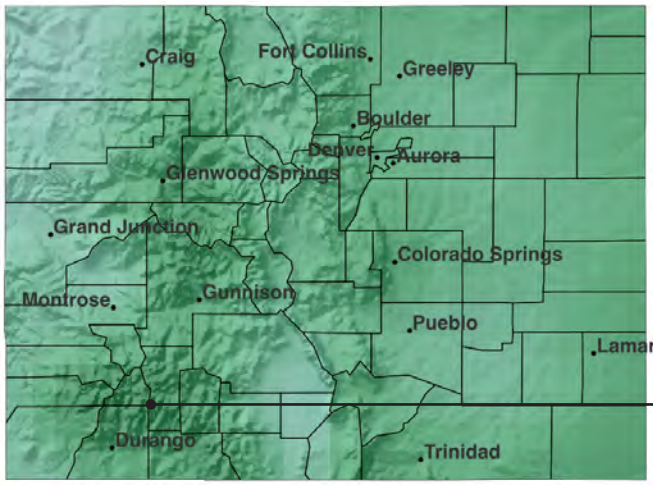
Figure 11. Extreme Precipitation Modeling[94]

Yearly average maximum one-day accumulated precipitation amounts

Precipitation (in)

0 1.4

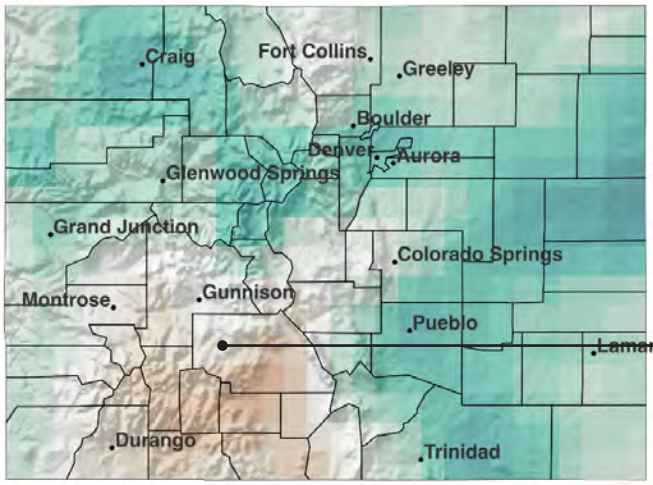
Today (1.1°C)



This hazard is indicative of the most intense one-day rainfall periods.

On average, climate models simulate totals up to 1.4 inches today. Like precipitation days, this is likely to be an underestimate due to coarse resolution precipitation inputs, but with realistic spatial patterns (e.g., with amounts peaking over the Rockies).

Change to 1.5°C

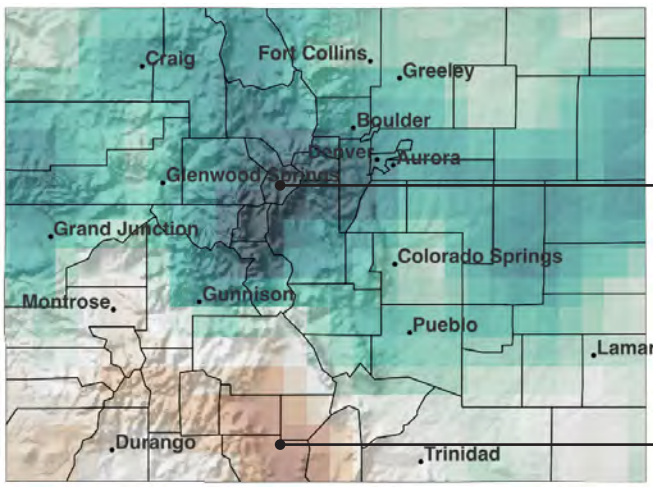


Changes remain within +/-5%, with a dipole change over the Rockies (wetter to the north, drier to the south) – but these changes could be within climate noise.

Relative change in precipitation (%)

-10% 0 10%

Change to 2°C



Increases of ~10% over the Northern Rockies and generally in the northern part of the state could contribute to increased flood risk.

Reduced intensity by ~5% in the San Luiz valley.

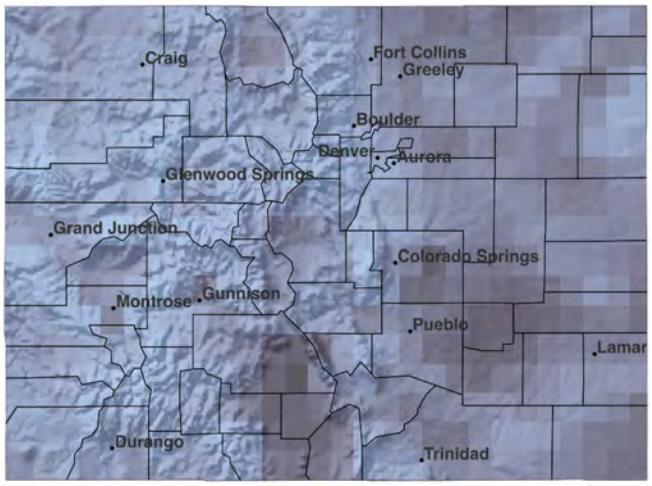
Figure 12. Pluvial (Flash) Flood Risk Modeling[95]

Pluvial flood relative risk as Annual Average Loss (AAL) — includes flash floods and surface floods

$ AAL per $1M

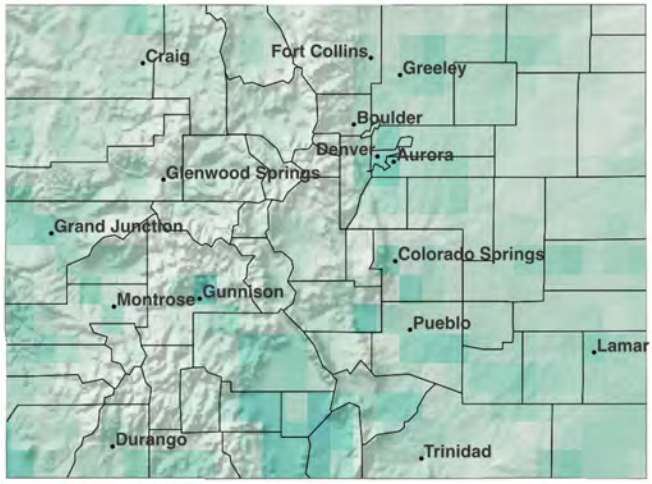
0 700

Today (1.1°C)



Pluvial floods are widespread and frequent in Colorado (particularly eastern Colorado) due to frequent heavy storms.

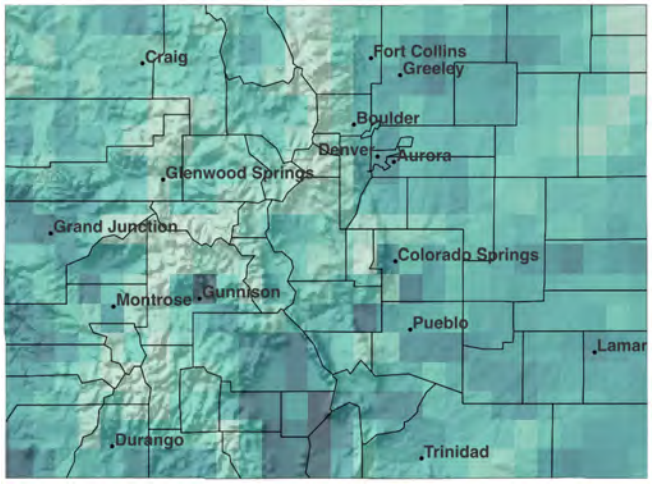
Change to 1.5°C



Change in risk ($ AAL per $1M asset value)

-20 20

Change to 2°C



Increases in risk under climate change are widespread but generally small (within 0.1% of a $1M asset value).

Flooding can be highly local: the mean risk and changes under climate change across 25 km grid cells is likely an underestimate.

Note: Risk is calculated as Average Annual Loss (AAL) across return periods of 50, 100, 200, 500 and 1000 year return periods.

Understanding the Risks: Domains and Geographies

Understanding how the key hazards will affect numerous aspects of Colorado and its people under potential climate scenarios will help prioritize what actions to take. This section serves to contextualize how the key hazards influenced by climate change are likely to impact four social and economic domains: natural systems, people and communities, built environment, and economic sectors. In addition, different impacts are experienced differently amongst different geographies within Colorado. This evaluation brings together aggregate social, environmental, and economic projections and considerations. It further incorporates key geographic considerations to better understand climate risk (risk = hazard x exposure x vulnerability). This more interrelated and contextual understanding supports the state's goal of better identifying near-term next-step action items that align with key priorities, needs, and opportunities. Each section highlights examples of action items the state will take as part of this roadmap, or is already pursuing to address key issues within each of these domains. These four domains overlap in a variety of ways, but this roadmap organizes them separately to better align risks (including geographic areas of higher exposure) with actions.

People and Communities

All Coloradans will continue to be affected by climate change. However, these impacts will not be experienced equally due to geographic, racial, social and economic conditions that influence a community's ability to adapt. Equity and environmental justice are top priorities for Colorado. Understanding the geographic distributions of these climate impacts will allow for a targeted approach to developing and implementing context-specific adaptation strategies to fit each area's needs and opportunities.

Notably, the state's disproportionately impacted communities (See Glossary for more detail), particularly those in the southeast, low elevation areas of the Western Slope, and urban Front Range, are likely to be exposed to more frequent and increasingly severe climate hazards and have fewer resources to adapt. For the Front Range population centers, extreme heat, water stress, and air quality are of particular concern, while for the Eastern Plains and Western Slope, combinations of extreme heat, water stress, and increased wildfire and grassland fire pose heightened risks.

Figure 13: Example Overlay of Heat, Fire, and Flooding Risk and Vulnerable Populations[97, 98]

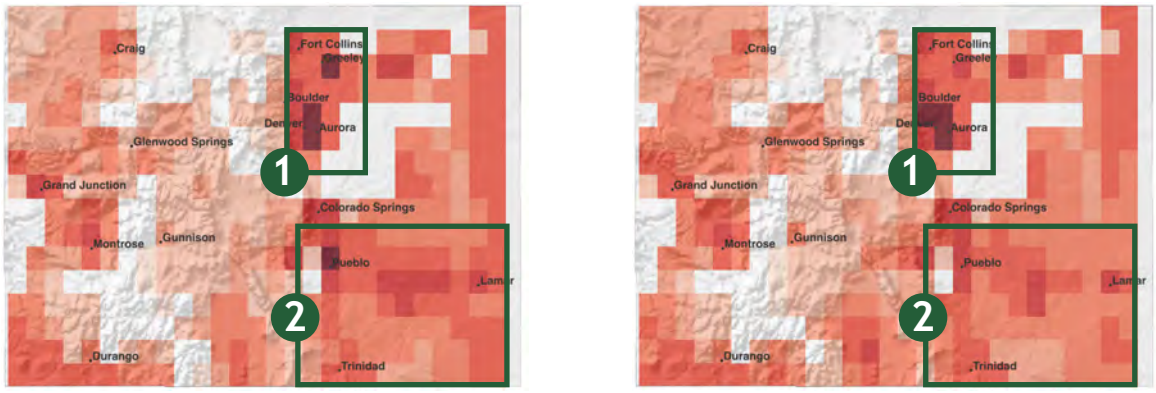
Climate: 1.1°C

Population: SSP2-2020

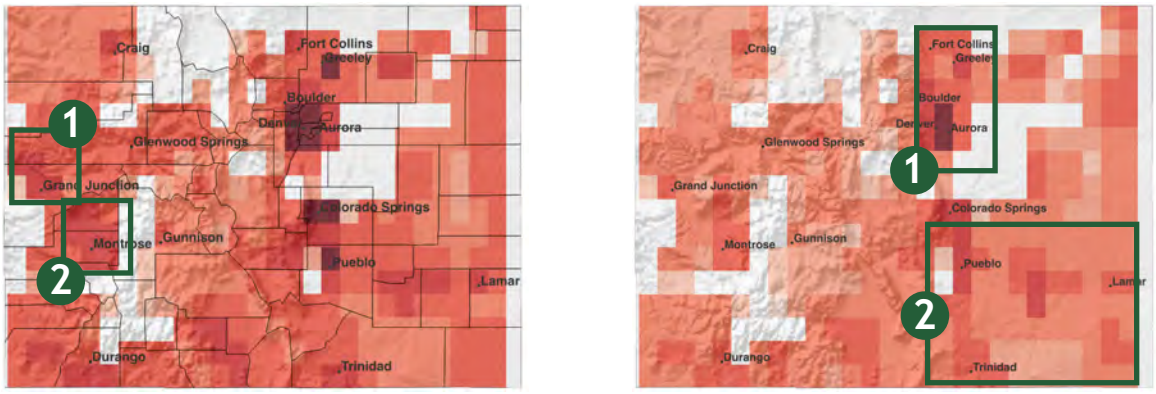
Climate: 2.0°C

Population: SSP2-2050

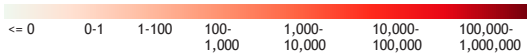
Heat & vulnerable population risk index



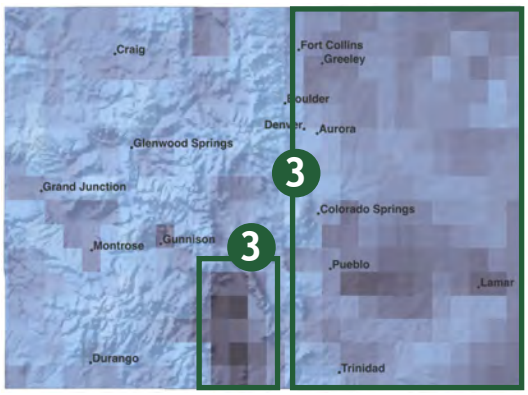
Fire weather days & vulnerable population risk index



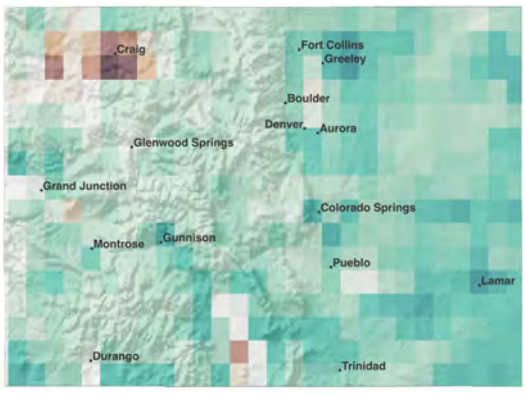
Population-days



Flooding asset risk index



$ AAL1 per $1M asset value



$ AAL1 per $1M asset value

1 **High population:** many people exposed to extreme heat and wildfire in urban areas.

2 **Vulnerable population and high hazard:** lower-income populations in the SE plains coincide with high extreme heat and fire risk.

3 **High hazard:** owned assets across eastern Colorado and San Luis Valley face high flood risk relative to the rest of the state, although changes relative to today are likely to be small at 2°C.

Population days represent the cumulative count of days when vulnerable populations face hazardous conditions—be it extreme heat or fire-prone weather.

Climate hazards such as wildfires and flooding can displace entire communities and cause economic stress, especially among those who earn low incomes or whose homes are uninsured or underinsured. Climate change poses risks to our physical health through extreme heat, water stress, climate-driven natural disasters, and decreased air quality. Economic hardships and stress related to climate hazards also impact the mental and behavioral health of Coloradans.

In general, heat impacts correlate in magnitude with low-elevation areas, such as the Eastern Plains and parts of the Western Slope. The relative change in heat in areas will also have impacts in many other areas, including in the mountains where communities are less accustomed to managing for heat and many buildings are not equipped to address heat stress. These changes may result in increased use of cooling or air conditioning where it currently is not used.

The urban heat island effect impacts areas of the Front Range, which is projected to see the majority of population growth by 2050 within the climate risk assessment. Colorado is likely to see increased heat-related illnesses. Older adults, young children, people with chronic illnesses, people with disabilities that are exacerbated by heat, people taking medications that impair temperature regulation, those who are unhoused, low-income communities, pregnant people, and outdoor workers are more likely to experience vulnerabilities to their health as a result of heat stress. Individuals who meet more than one of these criteria may experience compounding effects. Additionally, the State Demography Office also projects that the state's population will continue to age. Therefore, understanding how to best support older adults will be an important part of adapting and responding to climate hazards. Strategies include ensuring access to cooling sources, improving specific kinds of data collection, or educating health care providers and facilities about how climate change can impact health.

Impacts from combinations of factors are also threats to health, such as potential increases to nighttime lows in certain areas, which increases the risk of heat-related illness particularly for those who experience extreme heat during the day and do not have cooling at night.[99] For the elderly, those who cannot afford cooling at night, and those with certain illnesses, this heat stress can be particularly risky.[100] These impacts can be further exacerbated when extreme heat and wildfire smoke are experienced concurrently, requiring some people to choose between opening windows to cool their homes but allowing dangerous smoke-filled air into their homes, or prioritizing air quality at the expense of cooling.

While the Front Range population centers are projected to continue to grow, the number of Coloradans living in wildfire-prone areas has also increased, and the areas that face wildfire risk will continue to grow with climate change. Development in Colorado's wildland urban interface (WUI) is projected to increase from 300,000 homes currently to 720,000 homes by 2030, and the state is expected to experience up to a fivefold increase in acres burned by 2050.[101] The WUI is not a static definition, but a concept that applies in different ways to different circumstances. To put it another way, more than 1 million Coloradans live in areas with moderate to very high risk of wildfire.[102]

The correlation of floods and landslides after fire is anecdotally well known in Colorado, but the defined geographies don't always fit cleanly into definitions of the WUI or traditional flood zone mapping. Yet flood after fire has led to direct loss of life and property, and remains a key risk for Coloradans to consider and better understand.

The projected increase in wildfires also raises significant air quality concerns for communities beyond the WUI. Wildfire smoke will be particularly concerning for sensitive populations, including older adults and youth, individuals with asthma and respiratory conditions, those who work outside, and people whose homes, schools and workplaces do not have air filtration systems that can improve indoor air quality. Topography will also play a role, as areas such as the Front Range that experience inversion layers, which trap and keep smoke, will face greater exposure to unhealthy air conditions. This challenge is compounded for people living in these areas who have fewer opportunities and resources to escape the lingering poor air quality created by the inversion layer.

Highlighted Actions: People and Communities

Prioritize Action on Extreme Heat: The Colorado Department of Health & Environment (CDPHE) is prioritizing actions on extreme heat with a focus on public health readiness and response for Colorado's vulnerable populations and disproportionately impacted communities. CDPHE is participating in the Interagency Extreme Heat Workgroup and formed an internal CDPHE Extreme Heat Workgroup to coordinate and advance key actions, including expanding data surveillance on heat-related illness. The agency is advancing extreme heat and health resources and planning by developing the Extreme Heat Response Plan 2023 for Colorado's Long Term Care Facilities and Access and Functional Needs (AFN) populations. Looking ahead, the agency will develop a public health Heat Action Plan to respond to the presence of an extreme heat event in Colorado communities and prevent morbidity and mortality related to extreme heat.

Produce key resources and support capacity for the public and localities on extreme heat: CDPHE has already updated the Heat and Health website with additional information on vulnerable populations and improving language accessibility. CDPHE will leverage grant funding from the Centers for Disease Control (2024-2027) to provide technical assistance to local public health agencies to inform local action plans and build capacity on extreme heat.

Prioritizing disproportionately impacted communities and promoting environmental justice in state policy and enforcement: The governor's 2024/25 budget proposes $5.1M for environmental justice through the work of CDPHE's Environmental Justice Program and by advancing enforcement and compliance efforts for air, water, and hazardous waste in disproportionately impacted communities. Working to support through coordination, the CPO will work with the CDPHE's Environmental Justice Program to seek recommendations from the Environmental Justice Advisory Board about key questions at the intersection of climate change impacts and disproportionately impacted communities. The Environmental Justice Program will also pursue opportunities to continue improving Colorado EnviroScreen, including by exploring the incorporation of climate scenario information and data.

Advance technical assistance for local communities in pursuing federal funding: The state has actively sought to increase equity in pursuing federal funding at the local level, especially through technical assistance and support. The state has funded 14 Regional Grant Navigators embedded in Regional Planning Organizations. The state has also secured contracts and will soon be providing additional grant writing and navigation consultant support through the Regional Grant Navigators. DOLA's Division of Local Government provides technical assistance to communities, and the Department of Natural Resources (DNR) and Department of Agriculture (CDA) have funding assistance opportunities. The state has matching fund assistance available for local governments as well. Given the recurrent theme of adaptation and resilience amongst Infrastructure Investment and Jobs Act (IIJA) and Bipartisan Infrastructure Law (BIL) opportunities, the CPO will be working with the states Federal Funds team to grow an active network internally and externally focused on maximizing outcomes in this space.

Advance protections and best practices for outdoor workers: Colorado has nation-leading agricultural worker standards through passage of SB21-087, which includes standards that will ensure protection along with a changing climate. To ensure this law keeps pace, the governor's FY 2024/25 budget includes added staff at the Department of Agriculture on worker issues and to coordinate external stakeholder advisory groups regarding the implementation and needs related to SB21-087 and more broadly. The agency is also pursuing voluntary partnerships with industry leaders to support the establishment and adoption of best practices industrywide. Beyond agriculture, the Office of Future Work at the Department of Labor will be pursuing a statewide study on the future of work under climate change scenarios to better inform future state planning and future versions of this roadmap.

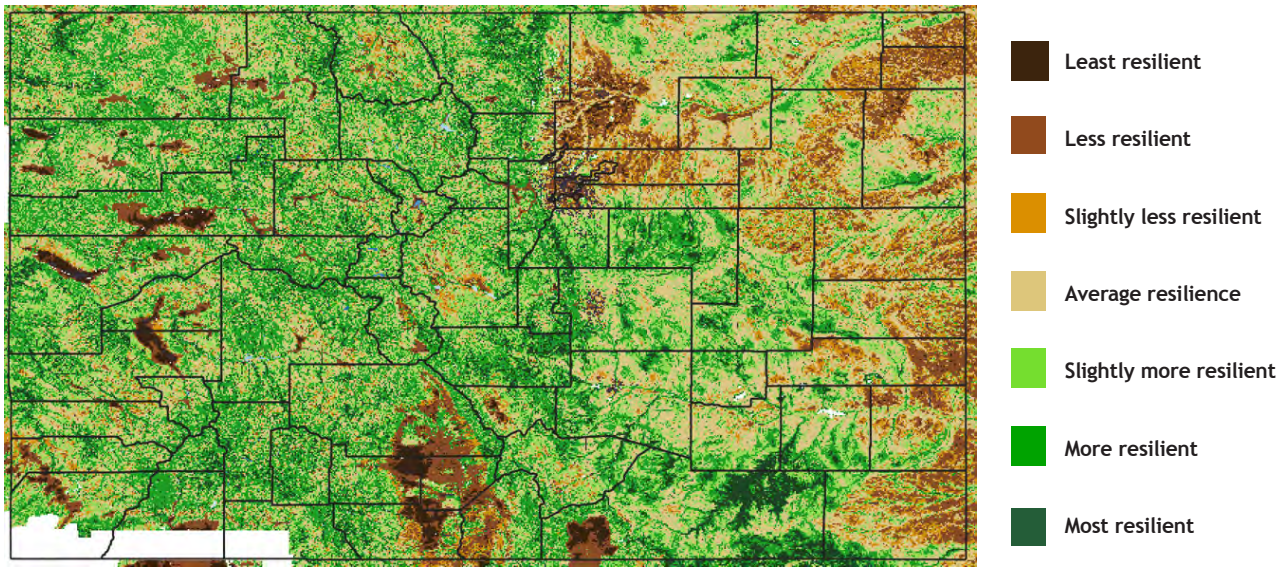
Natural Systems

Colorado's natural systems — our ecosystems, wildlife, water, forests, and grasslands — are and will continue to be impacted by climate change. With the outsized importance of natural systems and outdoors to our economy and environment, the focus on supporting the conservation and adaptation of our natural systems to climate change is critical for Colorado.

These systems have evolved to be closely tied to Colorado's unique weather, climate, topography, and elevation. Because of this, even small relative changes in the climate have meaningful impacts on the plants, invertebrates, and wildlife in Colorado's ecosystems. These impacts will be felt statewide. The Nature Conservancy's Resilient and Connected Network Analysis is a useful resource that can provide an indication of current levels of resilience across the state. Resilience in the natural systems space is also heavily tied to connectivity — the ability for animals to adapt to changes in their habitats through movement.[103] Ensuring connectivity of wildlands and creating resilient ecosystems is key to preserving biodiversity and the habitats on which it depends.

Areas across the state that are most likely to be affected by climate hazards and have a lower resilience are worth noting. While resilience levels vary greatly within small geographic areas, and across the state, areas on the far Eastern Plains, Front Range population centers and San Luis Valley have notable overlaps between heightened climate risk and lower resilience. The Eastern Plains are likely to face heightened and converging impacts from climate hazards, which can result in outcomes like reduced crop yield due to warming temperatures and drought, increased agricultural runoff, diminished water quality and depleted soil nutrients from flooding, and reduction in soil fertility from wildfire.[104] Colorado's grasslands serve as a critical carbon sink (absorbing more carbon from the atmosphere than is released) and provide valuable habitat and economic benefits. Levels of resilience to climate impacts vary across the state's grassland areas, but deserve particular attention given their important benefits and heightened risk from climate impacts (see Figure 14).

Figure 14. Climate Resilience Levels of Intact Natural Land[105,106]



Proper climate conditions are required to support ecosystems and landscapes. As the climate warms, temperature and precipitation may not remain within the proper range to support present landscapes.

Where land is less resilient, it may be susceptible to loss of native vegetation, soil erosion, and aridification without intervention.

Land managers can take action to increase resiliency of lands by conserving lands, restoring lands to natural landscapes, and including biodiversity and land resiliency in adaptation planning.

Note: Lands of the two federally recognized tribes are removed from the analysis until the results can be vetted by the respective nations.

Climate change also influences wildfire patterns and behavior. Wildfire is a normal and healthy part of forest ecosystems under normal conditions. However, wildfires are evolving due to changing fuel conditions, encroaching development, and increasing pressures on natural spaces. More destructive fires harm our watershed health, soil health, and our natural ecosystems' ability to regenerate plant life. Declining forest health further affects wildfire patterns and behavior. The Colorado State Forest Service actively researches these dynamics and considerations and summarizes management responses in the 2020 Colorado Forest Action Plan.

Warming temperatures are increasing invasive species and insect outbreaks; reducing streamflow, which influences species migration and reproduction; and increasing the risk of species extirpation. The combination of warmer temperatures, increased drought, earlier snowmelt, and intensified wildfires increases the ability of invasive species to impact ecosystems.

Our water systems are seeing climate impacts statewide, including wildfire impacts to mountain watersheds, shifting quantity and timing of runoff, and warming in-stream and wetland temperatures affecting aquatic life, fisheries, and the local businesses that rely on fishing and rafting seasons. Colorado's status as a headwaters state provides resilience benefits, but water scarcity and competition for water resources, while ensuring enough in-stream water for healthy ecosystems, will continue to present an important challenge for natural systems and the built environment. With ongoing negotiations and existing significant state attention, this report does not include discussions of interstate water issues or compact negotiations.

Highlighted Actions: Natural Systems

Coordinated approach on biodiversity and climate resilience for Colorado's outdoors: The Governor's Office of Climate Preparedness, Great Outdoors Colorado (GOCO), the Department of Natural Resources (DNR) and Colorado Parks and Wildlife (CPW) are convening the state's primary coordinated effort on climate adaptation of our lands and outdoors through the "Colorado's Outdoors Strategy". This effort aims to develop key metrics and goals, based on the best available science and data - including Indigenous Knowledge - and a proactive strategy to protect and steward our outdoors and the many benefits they provide. The strategy will provide a collaborative vision to align state entities, local Outdoor Regional Partnerships and others, to provide the greatest level of coordination possible to meet the significant challenges posed by the climate and biodiversity crises. The strategy will support outcomes that strengthens climate resilience and biodiversity and fosters inclusive, sustainable recreation opportunities. GOCO has committed over $5 million in total including $1.5 million for the development of the statewide strategy and over $3.5 million to provide planning and capacity needs for CPW and outdoor regional partnerships throughout the state.

Invest in and Coordinate on Biodiversity: Building on capacity added in SB22-206, the Governor's FY 24-25 budget includes ambitious new investments in biodiversity at the Department of Natural Resources and establishment of a State Land Board biodiversity program. As an outgrowth of Colorado's Outdoors Strategy, the Climate Preparedness Roadmap also includes the next-step action to ensure habitat connectivity and climate resilience are foundational components of updated recreation and conservation plans, including: the State Wildlife Action Plan (SWAP), CPW Habitat Connectivity Plan, and the State Comprehensive Outdoor Recreation Plan (SCORP). Furthermore, DNR will work to more clearly incorporate climate adaptation and biodiversity outcomes into conservation grant programs.

Improving species-level climate adaptation research and data: The forthcoming 2025 State Wildlife Action Plan update will include climate change vulnerability assessments, particularly for species of greatest conservation need, that address specific climate change-related threats, including declining snowpack, and propose responsive conservation actions. CPW will further improve habitat connectivity mapping to support this outcome.

Colorado's Water Plan, 2023 Update Implementation: The Colorado Water Plan provides a robust inclusion of future climate scenarios and adaptation considerations and remains the central and relevant planning document for water planning in Colorado. It identifies 50 agency actions and 50 partner actions to advance water security and related social and economic values in the face of climate-driven water scarcity and other environmental hazards.

Apply and Implement Wildfire Ready Watersheds Program Resources: The Wildfire Ready Watersheds Program was created to assess the susceptibility of Colorado's water resources, communities, and critical infrastructure to post-wildfire impacts and advance a program to assist communities in planning and implementing mitigation strategies to minimize these impacts. Through this program, the Colorado Water Conservation Board will be providing resources, coordination and guidance to support better local planning and implementation of projects that identify fire mitigation and fire impact reduction projects, and restore and rehabilitate watersheds, stream channels, and riparian areas (the interface between land and a river or stream) as well as protect infrastructure from flooding, sediment, and erosion.

Built Environment

The built environment — the places we work, live, and play — is a domain that is and will continue to be impacted by climate change, but it also serves a key role in climate adaptation (as well as a key role in climate mitigation).

Cities have traditionally tailored their built environment to local climate conditions, such as incorporating insulation for colder climates and adding air conditioning in warmer regions. However, the changing climate necessitates new adaptation strategies to prevent significant economic losses and damage to our built environment. According to the Future Avoided Cost Explorer (FACE), by 2050 Colorado is projected to experience annual damages that may range from roughly 2.2 to 4.2 times the present-day value, with annual costs escalating from approximately $620 million to $2.2 billion. The increase in flooding alone is expected to result in up to 4.2 times more damage to buildings.

The built environment is a critical factor in climate adaptation and mitigation, both at the individual building level and in broader land-use and planning. Strategic development must be an imperative across the state in order to meet the current and growing demand for housing and infrastructure in Colorado, while doing so in a climate-conscious and climate-prepared way. Developing strategically will support outcomes like: increased housing affordability; additional Front Range rail and transit-oriented development that reduces commute times, traffic congestion and pollution; reduced urban sprawl and improved community safety by mitigating risks associated with wildfires and floods and improving evacuation routes, while preserving natural systems and increasing access to greenspace. Strategic development will also support climate-resilient, energy-efficient, and water-efficient building practices, all critical outcomes in a climate-impacted future.

In our homes and schools, we must pursue strategies like promoting energy efficient cooling, which also better protects indoor air quality from impacts like wildfire smoke. In the face of more extreme heat events, electricity and utility providers, as well as businesses, schools, government, and building managers, will need to account for increased cooling needs, yet do so in ways that meet Colorado's greenhouse gas reduction goals. A significant opportunity will be to transition from the use of conventional air conditioning to the use of high efficiency heat pumps, which will both provide cooling and high efficiency heating, along with the use of geothermal heating and cooling technologies. Electrification will also support improved indoor air quality. Utility providers will need to continue to pursue resilience strategies to wildfire and other natural disasters, and water providers will need to address heat and water quality impacts to water infrastructure systems. The transportation system will need to focus on resilience, not only to acute hazards like natural disasters but more broadly to impacts from heat stress and regional workforce needs.

Colorado will have increased cooling needs, especially for underserved communities and institutional settings like correctional facilities, schools and long-term care facilities, and where they overlap with meaningful heat impacts like the Eastern Plains or within urban heat islands (See Figure 15). This also translates to a likely increase in electricity load during certain times. Colorado's urban heat island effect, especially in Denver, paired with strong solar rays influenced by elevation, will require urban centers to increasingly consider built environment cooling strategies. This may include designating community cooling centers, improving urban tree canopy, and promoting passive-solar design and aspect (the arrangement of doors, windows, and building design to ensure energy efficiency, light, and cooling) into new buildings. Adopting high efficiency building codes and maximizing deployment of high efficiency heat pumps and geothermal heating and cooling will be important strategies.

The impacts of extreme heat, coupled with water quantity stressors and wildfires in crucial watersheds, underscore the increasing importance of water and wastewater infrastructure. Prioritizing access to resources for cooling, clean water, and infrastructure updates for disproportionately impacted communities is key to reducing inequities. It is also crucial to reinforce water infrastructure for Eastern Plains, San Luis Valley and Western Slope agricultural communities, given the likelihood of extreme heat impacts there.

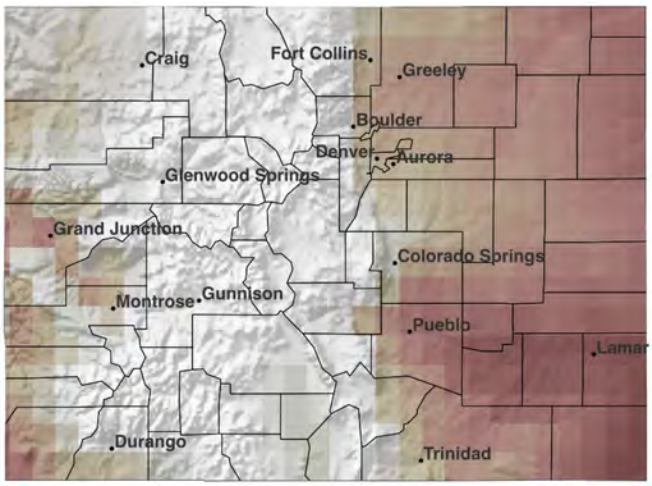
Figure 15: Cooling Degree Days Will Increase with Rising Temperatures, Increasing Energy Consumption[107]

Annual mean cooling degree days

Degree-days

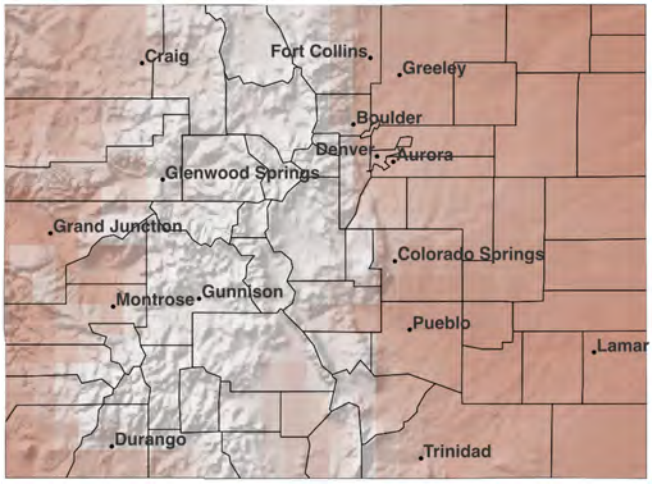
0 1,600

Today (1.1°C)



CDD accounts for both the frequency and severity of extreme heat, with the 65°F threshold typical for when there is a need for heating. High CDDs are found over the Eastern plains, particularly in the southeast.

Change to 1.5°C

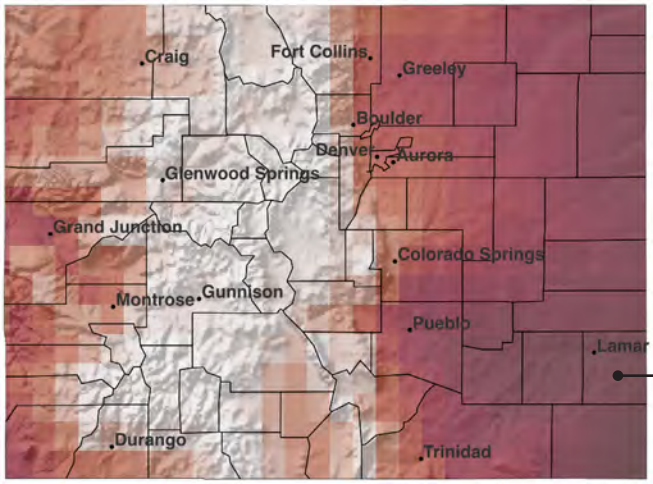


CDD changes follow the pattern of changes in the number of hot days, which are likely to increase over both the eastern and western plains.

Change in degree-days

-450 0 450

Change to 2°C



CDD shows large changes under 2°C. Changes peak in the SE and NE at ~450 days (equivalent to 22.5 more days >85°F and 15 more days >95°F). Large changes include populous cities such as Pueblo (350 more CDDs) and Lamar (420 CDDs).

Colorado has already seen devastating impacts from wildfires, with the 2020 wildfires alone causing over $16 billion in damages to the built environment.[108] As more Coloradans continue to move into the WUI, it will be important to encourage home hardening, defensible space, and fuels mitigation. The ignitability of a home is closely linked to building materials and design features. In the 2010 Fourmile Canyon Fire, Boulder County found that 100% of the homes built in the prior decade survived compared with only 63% of older homes.[109] The newer homes had all gone through a county program that required fire-resistant building materials and minimized flammable vegetation.[110] Enhancing the energy efficiency of both residential and commercial properties not only contributes to effective temperature regulation but also offers significant advantages in safeguarding these structures against ash and smoke infiltration during a fire. Wildfires can affect transportation and water assets within the WUI. Adopting a more comprehensive watershed-focused strategy for wildfire mitigation can help protect both water and transportation infrastructure from the adverse effects of post-fire flooding and landslides.

Future direct climate induced-flooding impacts to the built environment are less certain. It is less clear at this point if heavy precipitation events will meaningfully change in frequency or maintain relatively similar levels of flooding in the future; however, floods currently pose a notable risk to Colorado's built environment, so the risk remains notable even if it remains consistent with today.[111]

Greater flooding risks may be driven as much by built environment factors like floodplain development than climate-induced changes in risk.[112] It is important to look back at events like the 2013 floods, which caused significant destruction to the built environment. The floods impacted about a dozen counties along the Front Range, with considerable damage in Boulder, Larimer and Weld counties.[113] Prolonged heavy rainfall caused widespread flash floods, evacuations, destruction of infrastructure and homes, and sadly, loss of life. It was one of the most significant natural disasters in Colorado's history, highlighting the vulnerability of certain areas to extreme climate events and the importance of effective disaster preparedness and response.

Extreme weather is a high risk to Colorado, but it remains an area of lesser confidence with respect to how climate change will impact it in the state. Warmer temperatures from climate change may increase the likelihood of larger hailstones during intense storms; however the relationship is complex and is highly influenced by natural weather variability.[114] Hail has impacted the built environment in Colorado, damaging roofs, vehicles, and other property. Frequent severe hailstorms have led to substantial repair and replacement costs for homeowners, businesses, and insurance companies. Insurance claims related to hail damage have become a common and costly issue for both property and vehicle owners.

Highlighted Actions: Built Environment

Pursue strategic growth outcomes consistent with Executive Order 2023 -014: The state will continue to pursue actions that promote strategic development outcomes, and increase housing affordability. These broader efforts — such as promoting transit oriented development, Front Range rail, and reducing sprawl — are key co-benefit strategies for climate adaptation in Colorado. These strategies will reduce pollution, increase water and energy efficiency, help maintain ecosystems and connectivity, and increase the safety of the built environment with respect to wildfire and other hazards. Housing affordability and access is also a valuable climate adaptation strategy with the impacts of climate change experienced disproportionately by communities with fewer resources, including the unhoused. Added wildfire, land and wildlife management and other jobs are needed for mountain communities to support adaptation, making workforce housing affordability a critical adaptation need for these communities.

Continued on next page

Highlighted Actions *continued*

Promote natural climate and adaptation solutions such as strategic shade and urban tree canopy growth: The Colorado State Forest Service will be advancing grants thanks to federal funding to local communities and community organizations for urban tree canopy development. Because of the strong influence of shade and sun in Colorado, this is a highly valuable tool. The State Forest Service will also work to provide technical assistance, seek to coordinate, and use existing tools to help local communities that have separately received a large round of federal grants for urban tree canopy investments. Both of these funding opportunities will be administered consistent with the Justice40 Initiative, which aims to ensure certain federal investments flow to disproportionately impacted communities.

Promote built environment adaptation solutions that support health and equity outcomes: CDPHE working with state partners will provide best-practice information for opening community cooling/resilience centers and explore opportunities to leverage public-private partnerships for access to cool spaces.To help Colorado communities adapt to increasing heat, CDPHE will provide technical assistance and support to state agencies and local public health agencies to implement built environment strategies designed for multiple health benefits, such as working across agencies on projects like safe routes to parks, and helping local entities implement smart growth practices, and active transportation and shade tree canopy access. The state will further need to evaluate low-income cooling assistance opportunities.

Advance safety and preparedness in the wildland urban interface: The state has recently created the Wildfire Resilience Code Board, to establish a balance of statewide parameters and locally tailored building codes for new buildings in the wildland urban interface. This step will make the state more competitive for federal resilience funding. The state is also working to implement HB23-1273, and is working to acquire additional federal funding for this program, which aims to provide direct funding to home hardening and similar efforts. Working across several agencies, the state will increase guides, model guidance, resources, and public education to support local governments and property owners alike in improving safety within the wildland urban interface.

Promote access and equity in water infrastructure funding: CDPHE is working to advance resilience in water infrastructure and promote equity through exploring opportunities for localities to share certain resources and collaborate with respect to the use of state revolving fund dollars. Access to water infrastructure funding is a critical adaptation and equity consideration, as water systems in lower-income communities will need more support to adapt infrastructure to accommodate increased drought, flooding, and heat.

Advance resilience in transportation infrastructure: The Colorado Department of Transportation (CDOT) is actively advancing resilience and adaptation measures through Policy Directive 1905.0: Building Resilience into Transportation Infrastructure and Operations, CDOT's Risk and Resilience Tool and the Colorado Department of Transportation Resilience Program. As one example, the commission's late summer package of nearly $200 million was almost fully resilience oriented. As CDOT begins the development of its 10-year surface transportation plan, resilience and adaptation will be an even more central consideration. Additionally, CDOT is evaluating the details of specific points of failure along major state arteries, such as Glenwood Canyon, and will produce a report on the challenges and opportunities in the near term.

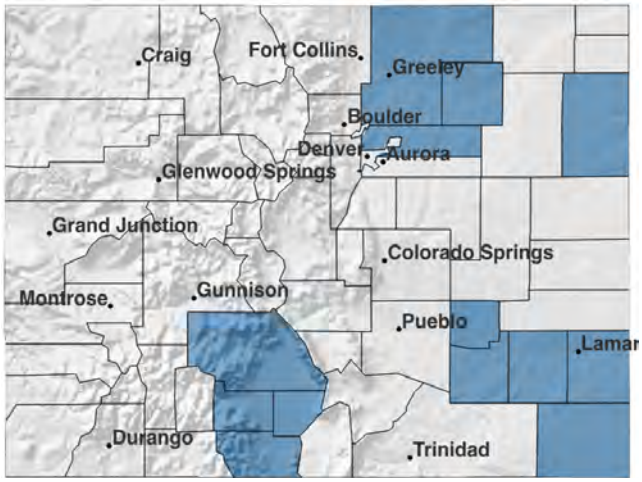
Advancing adaptation in new and existing buildings: The Colorado Energy Office will launch a rebate program in 2024 to support low- and moderate-income households in improving the energy efficiency of their homes, and in installing high efficiency heat pumps, which can provide clean and affordable heating and cooling. In addition, as of July 1, 2023, all local governments that are updating their building codes are required to meet minimum standards for energy efficiency and pre-wiring for heat pumps, which will help ensure that new construction and major remodels are able to be affordably heated and cooled. The office has also launched a geothermal grant program, and in 2024 will manage a new geothermal tax credit program, which will support low energy cost heating and cooling even under extreme weather conditions.

Economic Sectors

Colorado's private sector and main economic industries will face adaptation needs to meet the changing climate scenarios. Like other aspects of climate adaptation, this scope could be impossibly large and touch on nearly any aspect of life or business. Companies are increasingly undertaking their own climate risk analyses to better chart their own paths within a climate changed future. The climate risk analysis conducted for this roadmap evaluated key economic sectors in the state that face increased future risk to productivity based on geographic trends and other factors within the analysis. This roadmap does not include actions or recommendations for the private sector, but seeks to identify state government priorities, opportunities, and actions taking into consideration key economic sectors. Within this climate risk analysis, key economic sectors evaluated include agriculture, outdoor recreation and tourism, advanced manufacturing (including aerospace, beverage/bottling, clean-tech), utilities, and health care.[115] This is not an exhaustive list and is an area that will need more attention and analysis in future iterations of the Climate Preparedness Roadmap.

Figure 16. Counties Comprising State's Agricultural GDP and Workforce [117,118]

GDP



Workforce

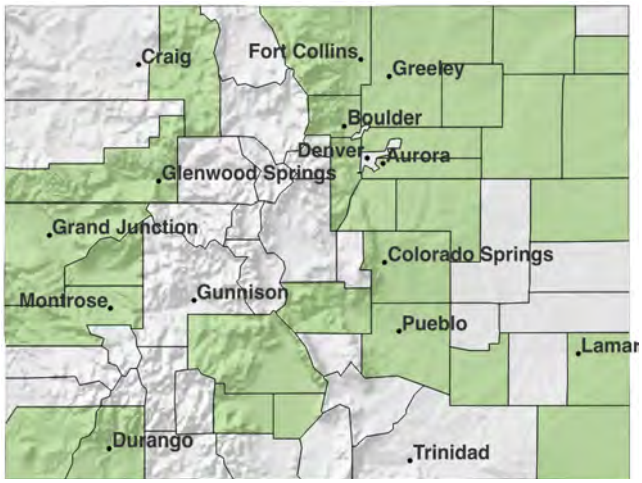
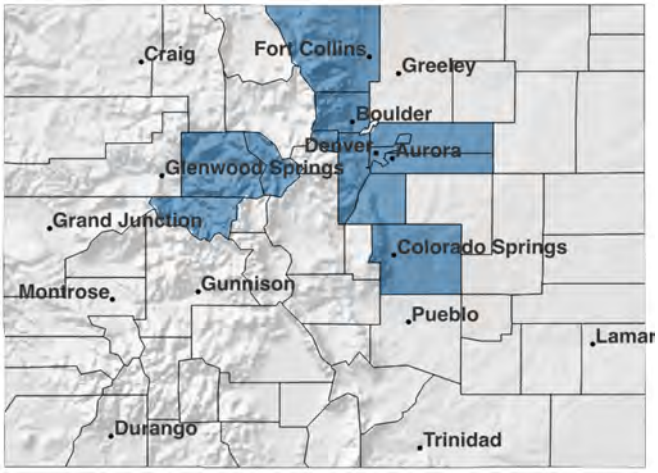
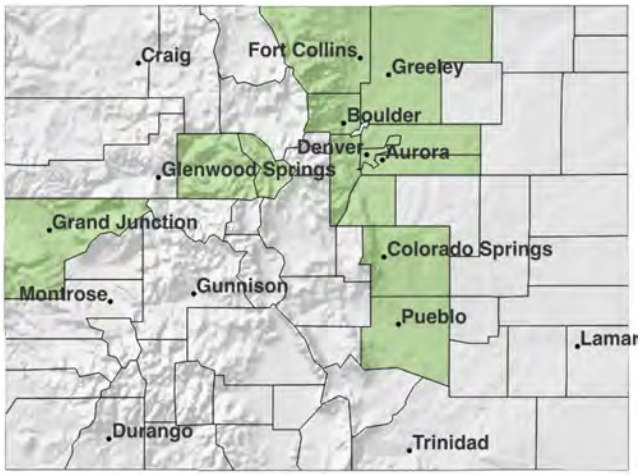


Figure 17. Counties Comprising State's Advanced Manufacturing GDP and Workforce [119,120]

GDP



Workforce

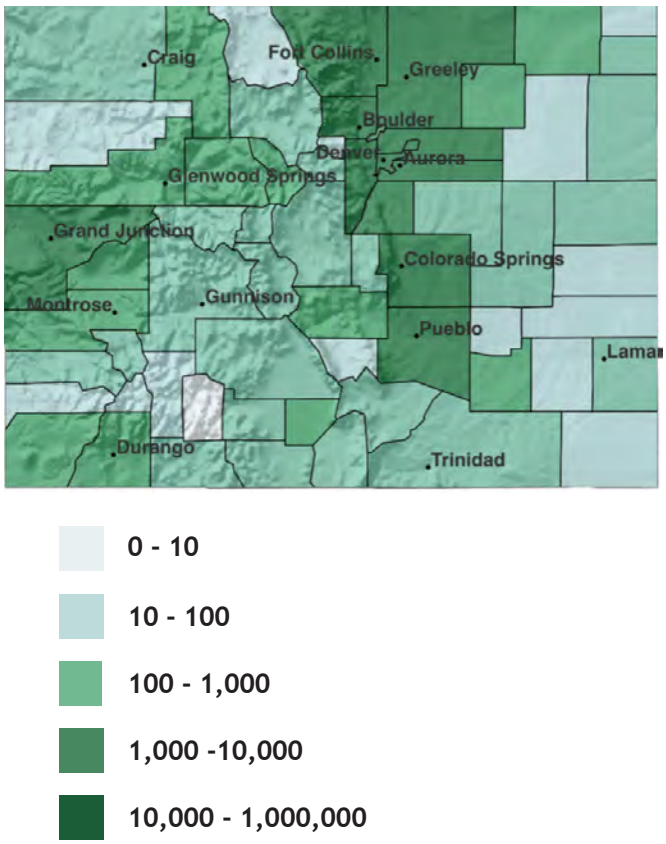


Colorado's $24 billion agricultural industry, a cornerstone of the state's economy, faces a variety of impacts from climate change.[116] For example, the agricultural sector directly feels the financial impacts of higher temperatures and heat stress on food production, in terms of adversely impacted animal health, decreased crop yields and potentially increased pesticide use. Colorado's Eastern Plains and certain areas in the Western Slope, where a large proportion of agricultural activity takes place, are expected to see the greatest increase in extreme heat in the state, negatively affecting production and compounding drought. These issues ripple throughout the state's economy, particularly in rural communities that rely on agricultural sales. For example, shifts in water availability, notably due to earlier snowmelt, can affect agricultural productivity.

Climate hazards affect advanced manufacturing and utilities sectors, with impairment to access goods in the event of floods, increased cooling needs in the event of extreme heat, and higher electricity demand during heatwaves. This is particularly pronounced in urban areas in the Front Range due to its large population and concentrations of advanced manufacturing and utilities industries. Reduced water supply from drought affects thermal power plants and hydropower availability.

Climate change poses meaningful challenges to the outdoor recreation and tourism sectors as well, with the potential to impact ski season length and quality, shifting runoff levels and times, increased wildfire risk, and high temperatures. Flash floods in recreational areas have led to evacuations and closures of popular tourist attractions. Changes in the timing, duration, and extent of tourism seasons could affect local and county budgets most reliant on tourism (some of which earn more than 60% of their revenue from tourism).[121] While the state must advance adaptation strategies working closely with the industry and workforce, it is worth noting that Colorado's elevation and status as a headwaters state, along with relatively high levels of resilience in key areas, provide some noteworthy advantages for Colorado's recreation and tourism over other states and regions.

Figure 18. Health Care Employees by County, 2021[123]



Within the advanced manufacturing sector, transportation systems have been disrupted by wildfires, post-fire rockslides and landslides, and flooding. Disrupted supply chains can affect the efficient flow of goods and services.

The increased occurrence of negative health outcomes resulting from climate impacts, such as heat-related illnesses and respiratory problems, may be costly for health care systems, the state, and individual patients. Illness may also directly impact the productivity of Colorado's workforce across economic sectors. It can also strain the health care system's capacity, especially during extreme heat events and intense or prolonged periods of wildfire smoke. For example, extreme heat events, natural disasters like floods and wildfires, and worse air quality can escalate the demand for medical services and specialized care.[122]

Highlighted Actions: Economic Sectors

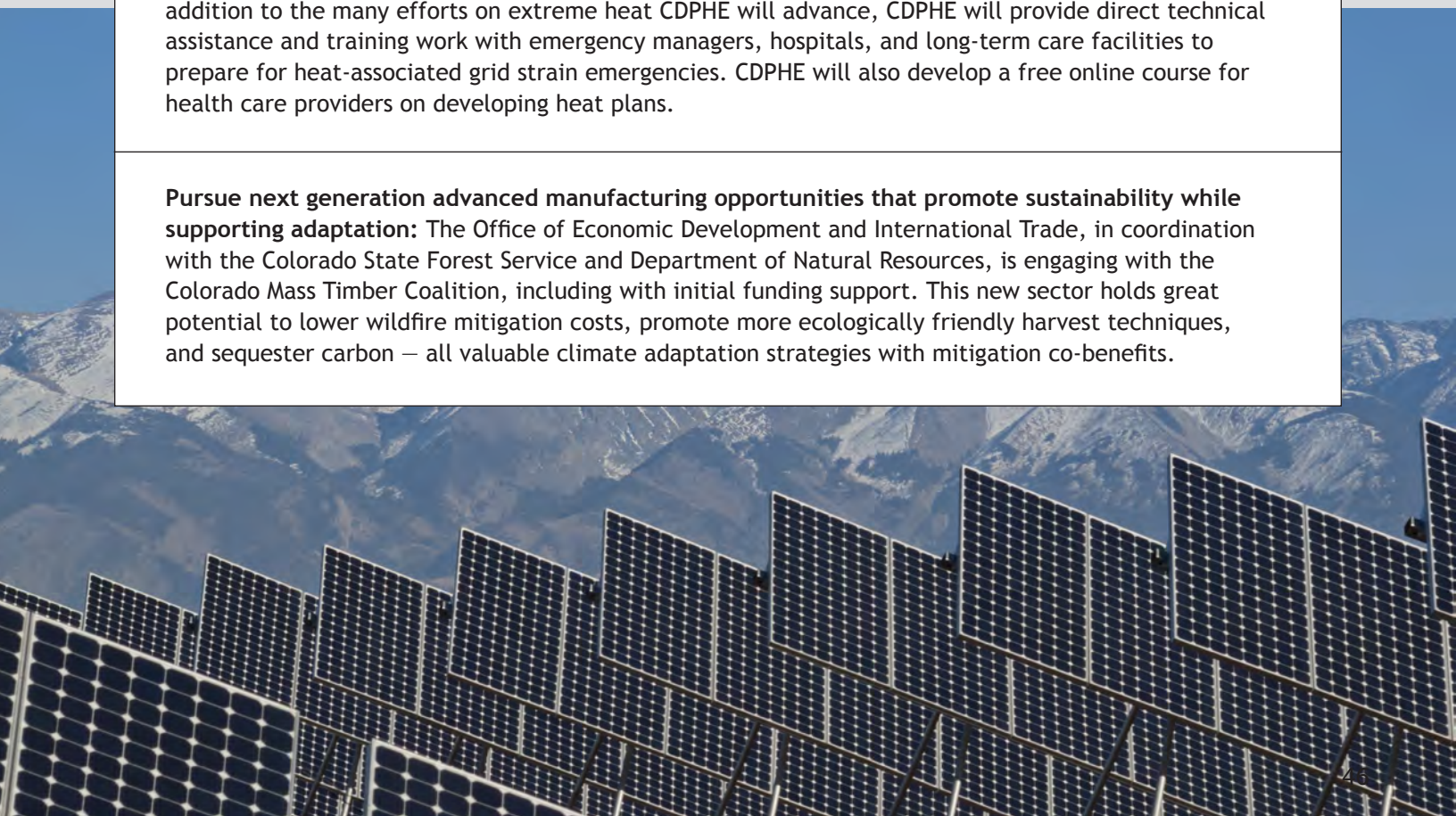
Addressing agricultural emergencies and advancing partnerships to support agricultural producers: The Colorado Department of Agriculture will seek to advance a number of new partnerships, resources and pilot projects to lower barriers for agricultural producers to pursue adaptation measures. CDA will improve technical assistance through partnerships with USDA and the CSU extension program, and will partner with ag producers on pilot projects to create accessible and digestible lessons learned, models and materials to share with agricultural operators across the state. As outlined in the governor's 2024/25 budget, the state will pursue the establishment of a Sustainable Ag Tax Credit, and will grow resources to respond to ag-related emergencies and natural disasters in line with the hazards posed by the changing climate.

Securing the electricity grid in the face of increased climate hazards and potential grid load: Utilities will face increasing pressures from a changing climate, including wildfire concerns, and increased load considerations. The state is undertaking an Energy Resiliency and Reliability plan to prioritize grid resiliency strategies while also offering grant programs to electric utilities such as Microgrids for Community Resilience and other electric grid resilience funds.

Supporting adaptation and sustainability in the outdoor recreation and tourism industries: The Outdoor Recreation Industry Office will be actively working with the industry to coordinate on state adaptation efforts and opportunities through engagements and working groups. The Colorado Tourism Office is developing a Destination Stewardship initiative to better understand and then promote sustainable tourism practices in Colorado, including climate considerations.

Secure health care infrastructure and support providers in advancing adaptation efforts: In addition to the many efforts on extreme heat CDPHE will advance, CDPHE will provide direct technical assistance and training work with emergency managers, hospitals, and long-term care facilities to prepare for heat-associated grid strain emergencies. CDPHE will also develop a free online course for health care providers on developing heat plans.

Pursue next generation advanced manufacturing opportunities that promote sustainability while supporting adaptation: The Office of Economic Development and International Trade, in coordination with the Colorado State Forest Service and Department of Natural Resources, is engaging with the Colorado Mass Timber Coalition, including with initial funding support. This new sector holds great potential to lower wildfire mitigation costs, promote more ecologically friendly harvest techniques, and sequester carbon — all valuable climate adaptation strategies with mitigation co-benefits.



Opportunities and Near-term Prioritization in Climate Adaptation

In order to narrow an impossibly large scope, a goal of this roadmap was to better identify areas that deserve a heightened level of attention and focus in state government. Through understanding hazards with a high level of risk and high level of confidence, contextualizing these risks within Colorado-specific nuances, understanding what the state is already doing and where potential gaps may exist, and gaining insight from external stakeholders on community needs and perceptions of state actions, several areas needing near-term or continuing attention became clear. These include: extreme heat; adaptation within natural systems including biodiversity; drought and water scarcity; agriculture; wildfire mitigation and preparedness; compounding impacts such as flood after fire; and areas home to disproportionately impacted and vulnerable communities. While the state should and will continue to act and adapt to known climate risks throughout state government, new or increased coordinated efforts and focus are important for these priority areas.

Looking beyond near-term areas of prioritization, as the state continues to advance climate adaptation efforts, several types of actions were identified as valuable to give increased attention to:

Coordination, Collaboration and De-siloing

Cross-agency and cross-sectoral collaboration and coordination will be important to ensure efficiency and policy coordination. Breaking down silos both internally and externally is highly valuable. This will include engaging with Colorado's world-class climate experts and the academic sector, non-governmental organizations, communities and community members — particularly from disproportionately impacted communities — private-sector actors, and state agencies.

Education and Technical Assistance

Colorado is taking many actions and creating valuable tools and resources in the climate adaptation space, but they may not be widely known or understood. It will be important to share education and communication materials, guides and model resources, and technical assistance to help individuals and communities to prepare for and respond to climate impacts.

Research, Assessment, and Program Integration

The state will need to support continued research and application of that research in key areas, such as species-level climate science data for wildlife, and for compound hazards such as post-fire flooding. Many current plans, policies and frameworks don't include a future-looking climate lens.

Community-Centered Approaches

Colorado should continue pursuing an equity-centered approach to climate adaptation, such as promoting environmental justice outcomes for disproportionately impacted communities.

These areas were identified through conversations across state government as well as with external stakeholders,with supporting analyses from DemosHelsinki and the Colorado Health Institute. These areas are not meant to be exhaustive, but rather are opportunities the state may consider as it expands its adaptation efforts.

Conclusion

This Climate Preparedness Roadmap will be renewed every three years to provide coordination, actionable next steps, and prioritization to better prepare Colorado for the impacts of climate change and promote a vibrant future for Colorado in the face of those impacts. This roadmap, the understandings gained and the actions outlined, will continue to be iterative even between roadmap versions. The Office of Climate Preparedness expects to provide updates, tracking and progress efforts like dashboards, and improved ways of sharing insights and information as new opportunities become available.

While this roadmap seeks to narrow an impossibly large scope by identifying priorities for near-term action, it is not exhaustive, nor will state action be limited to these areas. The state will continue to work on a multitude of initiatives that may provide co-benefits for climate adaptation and preparedness. The state will also continue to pursue activities necessary to solve important or pressing challenges. The Climate Preparedness Roadmap serves as a valuable resource to drive new opportunities, catalog and organize activities to support implementation, improve coordination, and track progress.

Given the scale and urgency of the challenge at hand, Colorado will continue to pursue both incremental and transformative adaptation. Incremental adaptation, such as carrying out wildfire mitigation projects, will allow the state to reduce risks more quickly in targeted areas of concern and opportunity. Transformative adaptation, such as designing cities and buildings to address heat and promoting strategic development to avoid climate risks, will facilitate systemic changes that address the underlying causes of climate vulnerability and design risk reduction into our systems and practices.[124]

As the Office of Climate Preparedness looks forward, including to the next roadmap, it will work to evaluate additional areas of focus and opportunities which did not have enough clear information on future Colorado-specific impacts. First, this roadmap lays out several additional areas of study or research that will inform next-steps related to those items. Additionally, it is possible broader topics like international climate refugee migration, climate-influenced infectious diseases, or changing federal activities may gain improved clarity and provide the opportunity to identify actionable and achievable state-level actions.

In addition, The Office of Climate Preparedness looks forward to continued work with a growing network of climate adaptation-focused teams across sectors, and to benefit from a growing body of understanding in the climate adaptation space. For instance, to further prioritize efforts going forward, the state may consider frameworks such as the Resist-Accept-Direct framework and the Pathways Thinking Framework as examples.

The **Resist-Accept-Direct** framework lays out three approaches for making management decisions for systems undergoing ecosystem transformation: 1) Resist, where managers work to maintain or restore ecosystem composition, structure, processes, or function on the basis of historical or acceptable current conditions, 2) Accept, where managers allow ecosystem composition, structure, process, or function to change autonomously, and 3) Direct, where managers actively shape change in ecosystem composition, structure, processes, or function toward preferred new conditions.

Adaptation Pathways Thinking is a planning approach that allows for uncertainty and change through imagining many different futures. This framework can be used to develop strategies for expected climate impacts, while not compromising or shutting off other options. The five-step framework includes (1) What is happening? (2) What is important to me? (3) What choices do I have? (4) What are the pathways? (5) How is it working?

The actions discussed in this roadmap seek to be actionable and achievable, with implementation, not just planning, as the ultimate goal. As implementation progresses, CPO, working with state partners, will seek to provide clear updates on implementation and highlight the progress being made. This will further help to inform the next iteration of the Climate Preparedness Roadmap and other coordinated state planning efforts. To support an iterative approach and produce the best understanding and implementation possible, the CPO looks forward to further growing networks with partners from the state's world-leading research community, local government and community leaders, and those with lived experience of climate change impacts. CPO also looks forward to developing supporting resources, like federal funding guides and accessible representations of information in this report like visualizer tools, for broader audiences to promote collaboration and shared understanding.

Agency-Organized Near-Term Action Items

The Climate Preparedness Roadmap will be updated every three years. The action items included in this section are designed to provide near-term, actionable and achievable next steps for the State of Colorado aimed at addressing identified climate adaptation needs, priorities and opportunities. These actions are not exhaustive, nor are the state's climate adaptation actions limited to these items, but they serve as an important organizing effort to ensure progress in key areas. It is worth noting that these actions are being coordinated with any concurrent planning efforts or ongoing activities. Mentions of ongoing efforts or planning processes are meant to identify them as a coordinated component of the state's broader work, not serve as an alternate or divergent plan.

The roadmap emphasizes an integrated approach recognizing the complex impacts of how climate change will alter the frequency and intensity of hazards on individuals, communities, natural systems, economic sectors, and our built environment. In addition to the impacts posed by individual climate-influenced hazards, the compounding effects of hazards pose additional challenges across domains.

The action items noted here encompass state agency-level actions, including planning, coordination, advocacy, program implementation and funding prioritization, capacity building, and increasing access to knowledge and technical assistance among others. As a first step, the state cataloged past and existing related actions to improve coordination and ensure that developed action items supported forward progress on climate adaptation. Several high-level overviews of ongoing activities are noted below as background, but these are not exhaustive. Collectively, these measures constitute a focused and concerted endeavor to advance Colorado's preparedness and adaptation in the face of the evolving challenges presented by climate change.

Over the coming years, the action items or recommendations included in this report that may have potential budget implications will be considered as part of the annual budget process, within the context of balancing the state budget. Under Colorado's constitution and laws, the General Assembly must approve any departmental or agency spending, as well as provide new fee authority. The voters must approve any new or increased taxes. The state will work to maximize the use of existing funds and evaluate additional targeted resource needs and revenue sources as part of the annual budget process as we move forward to implement the roadmap.

In the section below, background information or notable ongoing or past actions are included at the top of several agency sections to provide added context.

Governor's Office	
CPO	**Establish a lead coordinator for extreme heat to support efforts across agencies:** CDPHE, CRO and the Governor's Office worked with a University of Colorado master's capstone team to evaluate state government needs and opportunities with advancing outcomes on extreme heat. A coordinator to support work and coordination across agencies was identified as the first key need.
CPO	**Long-term coordinated strategy for state's multi-agency extreme heat work:** While this roadmap contains a number of immediate first-next steps with respect to extreme heat, it's clear that this is an area that needs a longer-term concentrated focus working across agencies. An ad hoc group has formed to coordinate on this multifaceted and pressing issue, but a clearer understanding of division of labor, needs, and opportunities amongst several agencies would be very valuable. A University of Colorado master's team analysis supported this approach.

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CPO	**Build the bridge for state agencies to Colorado's leading in-state experts via the creation of a state academic sector peer exchange and community leader networks:** Both state government feedback and feedback from leading state institutions suggested that building a bridge between these two sectors would improve outcomes in government, support de-siloing and increase efficiency through better sharing of resources and expertise. A coordinator role would serve to convene and actively engage Colorado's world-leading academic climate expertise, making their expertise, research and network more accessible to state agency staff working in this space. Similarly, creating additional network groups with local leaders and community organizations will similarly foster better collaboration.
CPO	**Build bridges to Colorado's leading in-state experts. Create a state staff research fund, similar to a program created in Oregon:** seeking to gain more direct access to research or analysis of research, providing even a small amount of resources to support state agencies commissioning research from state academic leaders. The fund would provide researchers with small amounts of support for research assistants or other nominal needs in carrying out research projects for the state.
CPO	**Integrate a climate adaptation lens into regular processes:** Evaluate annual legislative and budget submissions from a climate adaptation lens, and seek to strengthen proposals or align across agencies and initiatives where possible and appropriate. Evaluate opportunities to Integrate climate adaptation resources and planning into the annual budget and legislative development process where appropriate.
CPO, DPA	**Pursue adaptation and resilience outcomes with 'greening/sustainable government' efforts:** The recently signed Greening Government Executive Order, D-2023-018, establishes a Sustainability Office within the Department of Personnel and Administration (DPA), which will lead efforts to increase the sustainability of the state government. The Executive Order included considerations of climate adaptation needs in this work, and the Office of Climate Preparedness will work with the Sustainability Office to advance those adaptation considerations.
CPO, Operations	**Undertake a disaster recovery systems/after action report review:** The state should have a clear understanding of lessons learned, recommendations, and the status of those recommendations from recent disasters. The Climate Preparedness Office alongside the Governor's Operations Office will support an across-the-board review of after action reports and other key resources from recent past climate-related disasters to gain a better understanding of what the state has improved, corrected or may still need to take action on in order to improve recovery or preparedness processes for future disasters. This will include a look at how equity and language access are addressed in response and recovery systems.
OSPB	**Advancing longer-term budget analyses and understandings:** The Governor's Office of State Planning and Budgeting (OSPB) is currently evaluating opportunities to strengthen longer-term forecasts and outlooks and evaluate how to incorporate this information into budget analyses and decision-making. Working to strengthen longer-term budget forecasting by incorporating climate and related projections will allow the state to make better informed and more fiscally prudent investments over the long term.
CPO, Recovery/ Fed Funding Office	**Increase capacity and partnerships to get and use federal funds for Climate Preparedness:** The Federal Funds team along with the Office of Climate Preparedness and Colorado Resiliency Office will pursue efforts to grow a partner network and coordination effort internally and externally, including with tribal partners where able, to aid in uptake of federal funding related to climate adaptation and resilience building off work already done by the CPO to map potential opportunities.
CPO	**Identifying, supporting and coordinating federal advocacy on climate adaptation:** The CPO has already supported several agencies in navigating how best to provide comment and weigh in on important federal considerations/rulemakings, coordinate governor-level outreach and outreach to the federal delegation where appropriate. The CPO will continue to play a valuable role in helping agencies that don't have experience with federal advocacy navigate those opportunities.
ServeCO	**Further utilize Colorado Climate Corps and Youth Corps to support climate adaptation workforce and workforce pipeline:** Colorado Climate Corps is a multifaceted initiative helping to address many aspects of climate change including partnering with the Colorado Youth Corps Association on adaptation efforts like weatherizing homes, outdoor conservation work, wildfire mitigation, water efficiency, landscape and wildlife habitat restoration, urban greenspace advancement and many others. With the addition of CivicSpark, the reach of the Colorado Climate Corps now includes members supporting local governments and nonprofits in planning for and addressing sustainability and climate change issues, including supporting local drought and sustainability planning. Serve Colorado is working with additional partners to expand Climate Corps and support a holistic approach to addressing climate change in Colorado.
Colorado Commission of Indian Affairs (CCIA)	**Partner with appropriate state departments to ensure proper state-Tribal consultations, as necessary:** CCIA staff works with state departments and their Tribal Liaisons, to ensure strong state-Tribal partnerships and that those partnerships model a government to government relationship. Both the Southern Ute Indian Tribe and the Ute Mountain Ute Tribe have previously partnered with the state and local governments in wildfire mitigation, air quality and other environmental areas. For example, an intergovernmental agreement exists between the state and the Southern Ute Indian Tribe to develop and maintain the Southern Ute Environmental Commission.

Department of Natural Resources (DNR)	
Background and Ongoing:	Climate resilience, adaptation and biodiversity are increasing priorities for the state's lands, wildlife, and outdoors agencies. The Keep Colorado Wild Pass, Future Generations Act, and lottery-funded conservation initiatives have seen increasing revenue as designed. This has strengthened cash funds, and continued to provide new opportunities for the state to increase its actions on climate adaptation and resilience, biodiversity, and equitable access to nature within natural systems. Partnerships across state entities are aligning various planning efforts and programs, particularly with respect to Colorado's Outdoors Strategy, to improve coordination and provide best available science, metrics and resources with respect to climate resilience and biodiversity. This roadmap notes actions like the Colorado Water Plan and Colorado's Outdoors Strategy as overarching and key coordinating efforts across the natural systems space. DNR also administers a broad array of programs that are not detailed here, such as the Colorado Strategic Wildfire Action Program (COSWAP) which have seen meaningful recent investments and are carrying out valuable outcomes. Continuing to grow COSWAP and partnerships with the program to increase the scale and efficiency of wildfire mitigation projects remains a priority of DNR.
Gov, DNR, CPW, and GOCO	**Coordinated approach on biodiversity and climate resilience for Colorado's outdoors:** The Governor's Office of Climate Preparedness, Great Outdoors Colorado (GOCO), the Department of Natural Resources (DNR) and Colorado Parks and Wildlife (CPW) are convening the state's primary coordinated effort on climate adaptation of our lands and outdoors through the "Colorado's Outdoors Strategy." This effort aims to develop key metrics and goals, based on the best available science and data — including Indigenous Knowledge — and a proactive strategy to protect and steward our outdoors and the many benefits they provide. The strategy will provide a collaborative vision to align state entities, local Outdoor Regional Partnerships, and others, to provide the greatest level of coordination possible to meet the significant challenges posed by the climate and biodiversity crises. The strategy will support outcomes that strengthens climate resilience and biodiversity, and fosters inclusive, sustainable recreation opportunities. GOCO has committed over $5 million in total, including $1.5 million for the development of the statewide strategy and over $3.5 million to provide planning and capacity needs for CPW and outdoor regional partnerships throughout the state.
CWCB	**Colorado's Water Plan, 2023 Update implementation:** The Colorado Water Plan provides a robust inclusion of future climate scenarios and adaptation considerations and remains the central and relevant planning document for water planning in Colorado. It identifies 50 agency actions and 50 partner actions, such as urban landscape transformation that is water efficient, yet climate-appropriate, and identifying turf replacement options that support transformative landscape change. The water plan's actions advance water security and related social and economic values in the face of climate-driven water scarcity and other environmental hazards.
SLB	**Establish a State Trust Lands biodiversity program:** The governor's 2024/25 budget seeks a biodiversity program within the State Land Board to increase species and ecosystem biodiversity on state trust lands through the implementation of proven land, habitat, and species management practices, and ecosystem services leasing opportunities. Through land management methods and emerging lines of business, the Biodiversity Program will implement habitat restoration, species conservation, carbon management, and soil health practices based on modern stewardship science. The request will add staff experts in species and habitat mitigation banking, regenerative agriculture/soil health, carbon sequestration, and associated administrative support.
SLB	**Expand State Trust Lands pilot projects:** The State Land Board will continue to grow upon recent innovative pilot project successes, including carbon credit leasing, with its first lease approved in September 2023, and the development and expansion of a wildlife mitigation banking pilot program. Continuing pilot projects or other efforts and partnerships that support conservation, biodiversity, and wildlife outcomes or create diversified revenue opportunities will support adaptation efforts.
CPW, SLB	**Increase Parks and Wildlife biodiversity staffing:** The governor's 2024/25 budget provides for a significant increase in biodiversity-focused work at Colorado Parks and Wildlife to meet critical biodiversity and climate adaptation needs. It dedicates resources for CPW's State Wildlife Action Plan (SWAP) to conserve vulnerable species and habitats, supports wildlife populations and expanding public and private land access, and bolsters CPW's mission to perpetuate the wildlife resources of the state and the conservation of species of concern. The budget also provides staff in specialized roles that will help to maintain and enhance Colorado's biodiversity to offset the impacts of increasing human pressure on the environment, including staff dedicated to SWAP coordination, pollinators, amphibians, aquatics genetics research, species conservation data, resource stewardship, and aquatic and land habitats. The request promotes biodiversity by raising CPW's wildlife efforts focused on aquatics and diverse species conservation and increasing the impact of Colorado's SWAP. The additional funding will better allow CPW to maintain and improve the variety of flora and fauna and help address pressing issues, including increased drought, wildfires, rising river temperatures, and many other matters exacerbated by population growth and human development.

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CPW	**Promote further agency alignment on resilient habitat connectivity:** As an outgrowth of Colorado's Outdoors Strategy, and complementary planning efforts such as the Statewide Conservation and Outdoor Recreation Plan (SCORP) and Statewide Wildlife Action Plan (SWAP) updates, DNR will work to coordinate and incorporate north star biodiversity and climate adaptation goals and outcomes. This includes evaluating opportunities to more clearly incorporate climate adaptation and biodiversity outcomes into CPW-administered grant programs.
CPW	**Renew and strengthen the Habitat Stamp Program:** The Habitat Stamp Program provides valuable conservation opportunities, and is scheduled for a sunset review in 2027. Within this process, DNR will work to ensure habitat connectivity and climate resilience continue to be key components of the future program.
DNR, CPW	**Improve research and data on wildlife migration and connectivity for at-risk species of wildlife:** DNR and CPW will seek out opportunities to improve wildlife data sources. This improved data will benefit outcomes not only at DNR, but has been noted as a need with respect to wildlife crossings and outcomes associated with the state conservation easement program as well. Connectivity will be a critical source of information for the future of biodiversity in the state. CPW has recently hired a lead to support this work within the agency, as the result of SB 22-206, serving as a direct advisor to the director and supporting the coordination of improving access to and application of science with a specific eye toward the climate and biodiversity crises.
CPW	**Improving species-level climate adaptation research and data:** The forthcoming 2025 State Wildlife Action Plan update will include climate change vulnerability assessments, particularly for species of greatest conservation need that address specific climate change-related threats including declining snowpack, and propose responsive conservation actions. CPW will further improve habitat connectivity mapping to support this outcome.
DNR, CPW	**Pursue second generation actions from "Big Game and Corridors Executive Order" D-2019-011:** CPW and CDOT will work together to develop a coordination plan for conservation projects within proximity to where wildlife crossings have been developed to ensure protection of lands important to the success and functioning of those crossing structures. DNR and CPW will explore pilot projects for the development of wildlife-friendly fencing, and explore further investments in fencing upgrades and removals where appropriate. The Governor's Office will evaluate other options to improve outcomes or coordination related to EO D-2019-011.
DNR, DORA, CDA, CPO	**Grow conservation incentives and opportunities for private landowners:** The conservation easement program is a nation-leading program, and the state should ensure it functions well and achieves meaningful conservation outcomes. Similarly, incentives are actively under consideration at the federal level as part of the farm bill process. The state will work through federal advocacy and at the state level to support conservation outcomes. The state will further evaluate additional incentives and tools to support private land conservation efforts, including shared stewardship agreements with the Natural Resources Conservation Service as an example.
DNR, CPW, CPO	**Continue to pursue greater wildlife connectivity with federal land managers:** Through a settlement related to a 2019 action, the state has been working with BLM to realize a more coordinated approach to advancing connectivity outcomes for wildlife on Bureau of Land Management (BLM) lands. This effort was bolstered by a related national directive from the BLM. The state will continue to seek a partnership with the BLM for coordination and consistency with respect to strengthened wildlife connectivity on federal lands.
DNR, DFPC, CSFS	**Set shared goals and increase coordination across wildfire mitigation agencies:** DNR will coordinate the existing interagency working group in establishing clear goals, such as setting targets for achieving a percentage of at-risk communities within updated and actionable Community Wildfire Protection Plans (CWPPs). The Interagency working group will inform the governor of needs associated with achieving these goals. This will further serve to increase coordination across land management agencies and at a landscape level, increasing partnerships between the state, local and federal entities.
DNR, CSFS	**Create and distribute homeowner communication materials as part of the Live Wildfire Ready Campaign:** Working with the Colorado State Forest Service, Division of Fire Prevention and Control, Division of Insurance, and in coordination across related agencies, the Live Wildfire Ready Campaign will establish step-by-step guides on completing a home risk assessment, securing funding for mitigation work, and hiring contractors. The campaign will further evaluate additional messaging needs and opportunities. For instance, Utah has recently increased public education specifically about potential ignition sources (chains from vehicles, fire-pits/trash burning on private property etc.)
CPO, DNR	**Advocate federally for conservation of important wildlife and biodiversity outcomes on federally owned/managed lands:** With the majority of public lands in the state being federally owned and managed, advocacy at the federal level for conservation outcomes is key. Continue to advocate for federal protections of important landscapes holding biodiversity, resilience and connectivity characteristics such as the CORE Act and Dolores National Monument/National Conservation Area designations.

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DNR, CPW	**Pursue climate adaptation study, supports and outcomes for invertebrates and pollinators:** Complete and work to implement the Native Pollinating Insects Health Study, expected to be finalized early 2024.
DNR, CWCB	**Advance Wildfire Ready Watersheds Program outcomes:** The Colorado Water Conservation Board created the Wildfire Ready Watersheds Program to implement Senate Bill 21-240, which directed CWCB to assess the susceptibility of Colorado's water resources, communities, and critical infrastructure to post-wildfire impacts and advance a program to assist communities in planning and implementing mitigation strategies to minimize these impacts. CWCB conducted a statewide study to investigate the susceptibility of life, safety, infrastructure, and water supplies to post-wildfire erosion, sedimentation, flooding, and water quality degradation. Action Item: CWCB will work to ensure this resource is known and accessible and to support its application, including working directly with water managers and providing technical assistance. Furthermore, CWCB collaborated on guidance for local watershed advocacy groups and government agencies to produce high-resolution, local post-fire susceptibility analysis, and to identify fire mitigation and fire impact reduction projects to lessen community impacts. CWCB will work to advance adoption of these guides and analyses as a resource for local governments.
DNR, CWCB	**Advance Watershed Restoration Efforts:** In coordination with the Wildfire Ready Watersheds Program, CWCB is working with local partners to restore and rehabilitate watersheds, stream channels, and riparian areas as well as protect infrastructure from flooding, sediment, and erosion from wildfires. This work is supported through the Watershed Restoration Grant and Water Plan Grant Programs.
DNR, CWCB	**Improved flood Hazard Zone (FHZ) Mapping:** FHZ mapping is a science-based method that can be used to define areas that need protection, where mitigation measures can be implemented to protect downstream infrastructure, and to prioritize areas for restoration. As an action in the Water Plan, CWCB will further develop the FHZ Program to support state and local community needs by providing guidance on connecting FHZ mapping to stream management, watershed restoration, and Wildfire Ready Watersheds planning.
DNR, CWCB	**Strategically maximizing federal funding:** Federal funding is available for watershed, stream, and ecosystem restoration, but the availability of local matching funds for projects is limited. CWCB's grant program will work to be leveraged to maximize the amount of federal funding.
DNR, CWCB	**Technical support for floodplain restoration:** Process-based restoration, including beaver habitat growth and beaver mimicry structures, has emerged as an effective method of stream and floodplain restoration, but research on its influence over hydrology, stream temperature, and water quality is still limited. Action item: within one year, the state will report on research and engage key stakeholders about potential goals and next steps in this space.
DWR, CWCB	**Incorporate best available climate projections into dam safety programs:** With funding support from FEMA, CWCB has developed a climate-informed analysis of future flooding risk. This analysis provides scaling factors that help better understand future flood risk in future climate scenarios over the next century. CWCB is evaluating how best to incorporate this climate-informed data into its work and make the information available to communities and entities.The Division of Water Resources has adopted Guidelines for Comprehensive Dam Safety Evaluation Risk Assessments and Risk Informed Decision Making, which establishes priority review and review protocol for a comprehensive review of high-hazard dams. DWR will continue to implement the protocol.

Colorado Department of Agriculture (CDA)

Background and Ongoing:	SB22-206 created focused climate preparedness capacity in CDA. This capacity has been filled and is working closely with the Office of Climate Preparedness to advance climate adaptation efforts and outcomes. The lead position serves as a deputy director role in the Conservation Services Division. The position has all of the responsibilities of supporting the governor's Office in the development of the Climate Preparedness Roadmap in addition to having oversight and support of our primary climate resilience programs, including the State Conservation Board, Agricultural Drought and Climate Resilience Office, ACRE3, and Soil Health programs.
CDA	**Improve technical assistance through partnerships with USDA:** CDA will pursue partnerships with USDA Climate Hubs, and engage additional partners across the sector to expand connections with and accessibility of resources for producers. These hubs have developed valuable resources and seen good engagement with producers, including via a CSU working group on animal disease. CDA will work to grow that partnership and include more natural hazards.
CDA	**Pursue adoption of a Sustainable Agriculture Tax Credit:** This incentive would create a valuable tool to support the adoption of sustainability, conservation, and climate resilience activities, especially when considered in context of a lack of these elements within federal incentives and given some of the perverse incentives created by the current crop insurance system.

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CDA	**Improve technical resources for landowners and local governments for the adoption and siting of agri-voltaics** and other ag-friendly renewable energy sources that have adaptation co-benefits such as providing shade where valuable. Through already secured funding, the agency is evaluating immediate next steps which could include things like GIS siting tools, action guides for producers, and land users and other resources improving outcomes and lowering barriers to adoption and development.
CDA	**Partner with larger ag producers on pilot projects** that will provide lessons, examples and materials more easily adopted by smaller producers on topics, including resilience, better preparing supply chains for potential disruptions, exploring the use of grazing for wildfire mitigation outcomes, and other similar efforts.
CDA, CWCB	**Finalize current in-progress report with, and further increase coordination with, CWCB on water supply stability and resilience for agriculture.** Upon completion seek to implement the report's recommendations. In conjunction with this effort, CDA will work with CWCB and other related state agencies to then develop an Agricultural Water Strategic Plan to better define CDA's role in supporting farmers with dwindling water resources.
CDA	**Defined capacity within CDA to respond to ag emergencies**. The governor's budget proposes adding a program at CDA to improve communication on and grow a network of partners to respond to increased agricultural emergencies and disaster situations. This includes pests and disease along with others associated with the impacts of climate change.
CDA	**Additional study of the connection between invasive grasses and wildfire:** CDA will seek opportunities to gain better research or pursue the study of the nexus between invasive winter annual grasses and wildfire, helping CDA identify the most efficient opportunities to help address these impacts.
CDA	**CDA will grow and/or establish working groups with entities that have existing regional and local networks,** particularly on the Eastern Plains, like the Division of Fire Prevention and Control or the National Weather Service to advance technical assistance, coordination and initiatives related to climate and disaster preparedness.
CDA	**Pursue added partnerships with the CSU Extension program on preparedness education and training, for resources offered by the state.** A partnership between CSU Extension and CDA on climate preparedness would provide insight to CDA on how to best support producers on realizing resilience practices and insight on how to design/improve programs and incentives. The CSU Extension program is well respected by producers and would serve to open doors to CDA.
CDA	The agency is working to **expand the ACRE3 program**, which includes energy efficiency outcomes and other adaptation co-benefits,working with DOLA and CEO. This will include better resource guides and technical assistance opportunities for producers. The agency will produce an ACRE-3 strategic plan detailing this revamp.
CDA, CDPHE, CDLE	**Advance partnerships with producers and protections for ag workers:** Colorado has nation-leading ag worker standards through passage of SB21-087, which grants agricultural employees certain protections throughout each work period and requires agricultural employers to provide overwork and health protections to agricultural employees. The law already includes standards that will naturally support many needs consistent with a warming climate. As the climate conditions become more extreme in key regions where outdoor workers are employed, the agency will continue to evaluate these standards with key stakeholders and recommend improvements as needed. The governor's budget proposes a workforce decision item, adding staff capacity to support this work. The agency will also partner with external entities to explore voluntary programs that further incentivise best practices such as labeling or certificates similar to the fair food labeling program. CDPHE's Occupational Health program and CDLE's Office of Future Work will partner in these efforts.
CDA	**CDA and associated agency partners will implement strategies to improve the utility of state agricultural drought task forces (and related stakeholder/advisory processes):** The agency will work to improve effectiveness and relevance of the established drought task forces and seek to increase opportunities for technical assistance and best practices rather than simply conditions reporting.
CDA	**Expand and develop long-term strategy for the soil health program:** CDA's Saving Tomorrow's Agricultural Resources (STAR) Program has supported more than 400 farmers to improve the soils on their farms and ranches. This program provides financial and technical support for farmers and ranchers working to improve soil health, using practices such as no-till, reduced-till, cover crops, managed grazing, and compost application. CDA has received a federal grant to expand the program through 2026 and will work to identify it's long-term plan for the program before grant completion.
CDA, DNR, CSFS	**Implement Natural & Working Lands (NWL) Strategic Plan:** The NWL strategic plan outlines strategies to ensure Colorado's cropland, rangeland, grasslands, forests, wetlands, riparian areas, and urban greenspaces are managed to maximize climate resilience, sequester carbon, and reduce GHG emissions. The strategies in this plan require collaboration across jurisdictions, along with a wide range of stakeholder groups and federal partners. The Strategic Plan includes near-term actions for the next three years.

Colorado Energy Office (CEO)	
Background and Ongoing:	The state is undertaking a Microgrids and Grid Reliability Roadmap to prioritize grid resiliency strategies while also offering grant programs to electric utilities such as Microgrids for Community Resilience and other electric grid resilience funds. Furthermore, there are several items CEO Is currently coordinating or advancing via the GHG Roadmap 2.0 process that have significant co-benefits for adaptation. As the climate changes, the cost burden associated with cooling will increase as will the associated strain on utility grids. Planning for increased cooling needs involves local, state, and federal coordination on building codes, tenant protections, bill assistance and financing programs, and utility regulation and planning. These are questions that require additional robust processes and may provide opportunities for future versions of this roadmap but are not at a detailed actionable point for inclusion here.
CEO	**Updating clean energy planning for 2040:** New analysis shows that the lowest-cost pathway to provide electricity to Coloradans in 2040 achieves approximately a 98.5% emissions reduction. To lock-in these emissions reductions while ensuring affordable and reliable energy, the state is proposing to update the Clean Energy Plan process for utilities after 2030 to continue reducing emissions from the electric power sector. (Item independently being considered in GHG Pollution Reduction Roadmap 2.0 process)
CEO	**Distribution system planning reforms for new electric loads:** This policy framework ensures utilities have the flexibility and planning horizon to ensure adequate, timely, and cost-effective electricity service, such as to accommodate new cooling loads to provide air conditioning. This effort is also paired with additional efforts aimed to quadruple heat pump deployment in Colorado by 2030. (Item independently being considered in GHG Pollution Reduction Roadmap 2.0 process)
CEO, DNR	**Modernizing transmission and clean energy permitting and siting:** To achieve energy affordability and climate change goals, a significant amount of new energy sources will need to be constructed and connected to the grid to deliver clean, lowest-cost power across the state. This initiative focuses on providing a consistent framework for review and approval of new energy infrastructure to also minimize delays and land use and wildlife conflicts. Avoiding wildlife and habitat conflicts is a valuable climate adaptation co-benefit.
Multiagency	**Pursue land use policies to support more housing in compact, walkable neighborhoods near jobs and transit, while disincentivizing sprawl:** Developing strategically will support outcomes like: increased housing affordability, Front Range Rail and transit-oriented development reducing commute times, traffic congestion and air pollution; reduced urban sprawl and improved community safety, mitigating risks associated with wildfires and floods and improving evacuation routes, while preserving natural systems and increasing access to greenspace. Strategic development will also support climate-resilient, energy-efficient, and water-efficient building practices, all critical outcomes in a climate-impacted future. (Independently being considered in GHG Pollution Reduction Roadmap 2.0 process.)
CEO	**Electrification plan for buildings:** Increased access to efficient cooling is a clear response to a warming climate. This effort focuses on existing state and federal incentives and resources, as well as new policies and programs, to increase the use of high-efficiency electric heating and cooling systems. (Item independently being considered in GHG Pollution Reduction Roadmap 2.0 process.)
CEO, DOLA	**Implement a transformational housing program that includes energy efficiency requirements and holistic technical assistance:** This action would have significant co-benefits related to wildfire smoke, home hardening outcomes, cooling and equity outcomes among many others. (Item independently being considered in GHG Pollution Reduction Roadmap 2.0 process.)
CEO	**Advancing resilience in new and existing buildings:** The Colorado Energy Office will launch a rebate program in 2024 to support low- and moderate-income households in improving the energy efficiency of their homes and in installing high efficiency heat pumps, which can provide clean and affordable heating and cooling. In addition, as of July 1, 2023, all local governments that are updating their building codes are required to meet minimum standards for energy efficiency and pre-wiring for heat pumps, which will help ensure that new construction and major remodels are able to be affordably heated and cooled. The office has also launched a geothermal grant program, and in 2024 will manage a new geothermal tax credit program, which will support low energy cost heating and cooling even under extreme weather conditions. This effort is funded by $140 million from the federal Inflation reduction Act.

Colorado State Forest Service (CSFS)	
Background and Ongoing:	The Colorado State Forest Service administers numerous forestry research, forest health, and wildfire related programs. This roadmap coordinates with and builds upon this existing work, including the 2020 Colorado Forest Action Plan, the Colorado Forest Atlas and Wildfire Risk Viewer, and the Forest Restoration and Wildfire Risk Mitigation Program (FRWRM) among other existing initiatives. Recent significant investments in programs and activities at the Colorado State Forest Service and partnering wildfire-related agencies can be found in recent governor's budget packages.
CSFS	**CSFS is improving the Forest Legacy Program in Colorado:** This aligns with one of the 2020 Colorado Forest Action Plan goals; keep forests as forests. The purpose of the Forest Legacy Program is to protect private forest areas that are threatened by conversion to non-forest uses. The program is funded by the USDA Forest Service and administered in Colorado by the CSFS. It provides an opportunity for private landowners to retain ownership and management of their land, while receiving compensation for unrealized development rights. The CSFS requested and received additional capacity support for the Forest Legacy program and is currently working with key partners to identify the best approach for expanding Forest Legacy capacity in Colorado. Plans include providing additional assistance for due diligence activities, increasing outreach to landowners, simplifying the Colorado state application, and increasing efficiency to better utilize IRA and other Forest Legacy funding opportunities.
CSFS	**Extreme Heat and Strategic Deployment of Federal Urban Tree Canopy Funding:** Recent federal investments in urban and community forestry at both the CSFS and directly in communities provide significant influxes of funding for expanding urban tree canopy cover and supporting extreme heat equity outcomes. The state will seek to work with communities to coordinate for the best use of these funds and provide technical assistance around increasing urban tree canopy and growing the workforce and capacity to maintain urban forestry programs. With this funding's use under federal Justice40 initiatives, this effort will also produce valuable equity outcomes.
CSFS	**The state will pursue additional federal partnerships for wildfire mitigation outcomes and maximizing federal funds:** The state has long-standing shared stewardship MOU's with the U.S. Forest Service and with the BLM. The state will seek to pursue a shared stewardship MOU with the Bureau of Land Management and USDA Natural Resources Conservation Service (NRCS) to increase the wildfire mitigation project and funding opportunities. The federal land management agencies have a 2030 commitment under the federal wildfire strategy and are pursuing the treatment of roughly 30 million acres across adjacent lands. The state does not currently have a shared stewardship MOU with the BLM, and pursuing an MOU with NRCS will serve to bring to bear the full suite of NRCS dollars for private landowners.
CSFS	**Add capacity for state leadership on urban forestry:** Urban tree canopy will be an increasingly valuable tool for Colorado given the value of shade in cooling. This is also a focal point of federal funding that is flowing both directly to local communities and to the state to administer through grants. The program will seek to add capacity to support the administration of this funding.
CSFS, SLB, CPW	**Adaptive Silviculture forum/study/recommendations:** The State Forest Service, in partnership with the U.S. Forest Service, State Land Board, Colorado Parks and Wildlife, and private landowners, will continue to participate in research projects related to adaptive silviculture from a climate adaptation lens. Three of these studies are supported by the Adaptive Silviculture for Climate Change program, including projects on the Gunnison and San Juan National Forests and the Colorado State Forest. These projects provide the ability to experiment in real time as it relates to climate and resilience. The CSFS has received congressionally directed spending for the project at the State Forest and will begin to execute treatments in 2024 as well as work with federal partners to fully realize the San Juan and Gunnison projects.
CSFS	**Pursue federal partnerships for the CSU tree nursery and continue to advance pilot projects with external partners to advance test cases for reforestation in future climate change scenarios:** Next steps are getting seeds into the ground and growing the reforestation pipeline, working with federal partners on Research & Development and on restoration. The tree nursery has received funding influxes the last two legislative cycles that will be evaluated for match with federal partnership dollars.
CSFS, CDA	**Improve state understanding of woody biomass including biochar:** The CSFS has been conducting a study to characterize and quantify wood biomass resources across the state using USDA Forest Service Forest Inventory and Analysis (FIA) data. It will also evaluate harvesting, transportation, delivery systems, utilization and markets; energy production technologies; the social, economic and environmental considerations associated with utilization; and provide procurement and policy recommendations. This study will be integrated with other ongoing studies, including the statewide carbon accounting framework (HB 22-1012) and the CSU study concerning biochar utilization for plugging oil and gas wells (HB 23-1069). The state will work to complete this study, consistent with what is also proposed in the GHG 2.0 roadmap. Additionally, the CSFS will begin to develop a carbon co-benefit framework for forest management (HB 22-1012).

Colorado Office of Economic Development and International Trade (OEDIT)	
OREC	OREC is increasing its work with the industry on climate considerations. A recent strategic planning process has considered some of this scope. In this line, the OREC office will create or work with existing industry working and advisory groups to help the state support the industry in navigating climate impacts. The groups will serve to advise the office on how best to work with the industry in advancing climate adaptation outcomes, while simultaneously advancing the Office's understanding of how best to undertake this work while supporting Colorado's world-class outdoor recreation economy and ski industry, as well as outdoor workers such as guides.
OEDIT, CSFS, DNR	The Office of Economic Development and International Trade, in coordination with the Colorado State Forest Service and Department of Natural Resources, **is engaging with the Colorado Mass Timber Coalition and working to explore options to expand market opportunities for low-diameter timber in order to reduce the costs of carrying out wildfire mitigation work.** OEDIT has provided initial funding to this effort and will continue to evaluate future support opportunities as appropriate. This new sector holds great potential to lower wildfire mitigation costs, promote more ecologically friendly harvest techniques, and sequester carbon — all valuable climate adaptation strategies with mitigation co-benefits.
OEDIT	**OEDIT is leading the partnership to establish an NSF Climate Resilience engine in partnership between Wyoming and Colorado.** The effort would bring in $160M over 10 years for research, development, and applied strategies related to climate mitigation, adaptation, and resilience. Furthermore, OEDIT is working with Wyoming to explore creating a two-state climate tech-focused venture capital fund to complement the NSF Engine, including resilience considerations.
OEDIT	**Investing in private sector resilience and adaptation solutions:** As part of its Advanced Industry programming, OEDIT provides an ongoing series of grants, angel investment tax credits, and export assistance to companies, investors, and infrastructure in the energy, natural resources and cleantech sectors, and has and will include investments that boost resilience and adaptation outcomes in the private sector.
OEDIT	**The Colorado Tourism Office is developing a statewide Destination Stewardship Strategic Plan and eight regional plans to foster sustainable tourism and enhance Colorado's long-term resilience.** While in the development phase, this work will support our state to balance the quality of life for residents alongside the experience for visitors while protecting our natural environment, cultures, and communities. The agency will continue to develop this highly collaborative work, coordinating across agencies, to ensure strong climate adaptation considerations within its scope. It will further work to implement this effort leading to direct more-sustainable tourism outcomes. Additionally, across Colorado the CTO is working to support and promote sustainable tourism to mitigate the industry's impact on our environment and wildlife through industry programs and the stewardship campaign, Do Colorado Right.

Division of Insurance (DOI)	
Background and Ongoing:	In response to the escalating frequency and intensity of wildfires in Colorado, the legislature passed HB 22-1111, Insurance Coverage for Loss Declared Fire Disaster, in 2022. This law addresses prolonged displacement periods and delays in personal property replacement and home rebuilding for many Coloradans. Policyholders now have 36 months from the initial payment of actual cash value to provide receipts and invoices for replacement costs, with the potential for (2) six-month extensions in the event of unforeseen delays. Payments for loss of use, debris removal, and damages to landscaping are expected to be processed by insurers within a specified period of time.
DOI	**The Fair Access to Insurance Requirements (FAIR) Plan (HB23-1288), was created to provide property insurance coverage when it is unavailable through traditional means.** The governor has appointed the FAIR Plan Association Board, and the Board has begun meeting and working toward developing its plan of operation, required by July 1, 2024.
DOI	As a result of HB23-1174, Homeowner's Insurance Underinsurance, **the Division is exploring recommendations to address homeowner insurance affordability** and, beginning April 2025, will prepare an annual report on reconstruction costs to help homeowners better understand those costs. The agency is also working on a report — Wildfire Risk, Our Homes, and Our Health — which provides a risk analysis and community spotlights on the nexus between wildfire, homes, and health with the Colorado Health Institute.
DOI, DFPC, CSFS, DNR	**Pursue partnerships with the industry and other private entities to advance public education and wildfire mitigation outcomes:** The Division of Insurance will work with agency partners to pursue public-private partnerships where available to advance coordination with the industry to achieve public education and wildfire mitigation outcomes and identify ways to increase insurer transparency for mitigation requirements. Coordinating on messaging, resources, and dissemination of information across platforms will help to increase public awareness and education in efficient ways. The Division is also developing additional strategies with stakeholders and other departments, including education to homeowners on fire mitigation and home hardening, coordination on debris removal, and evaluating innovative ideas on mitigation strategies.
DOI	**Pursuing Innovative Strategies:** The Division began a series of stakeholder meetings in August 2023 to discuss homeowner insurance affordability and potential solutions. In September, the Division also released a request for information to get feedback on using parametric insurance to address such concerns. The Division will be working to evaluate this concept given the RFI responses and develop potential policy concepts if determined appropriate.

Colorado Department of Education (CDE) and Colorado Department of Labor and Employment (CDLE)	
Background and Ongoing:	CDE worked with CDPHE during the pandemic to improve practices and equipment related to indoor air quality. A number of those outcomes still remain and will provide co-benefits with respect to wildfire smoke when necessary. CDPHE also implemented the Clean Air for Schools program, which equipped early childhood education and K-12 schools throughout the state with tools and resources to monitor and improve indoor air quality, which will provide co-benefits with wildfire and heat. Fact Sheet (printable); Frequently asked questions (printable); website: https://cdphe.colorado.gov/clean-air-for-schools. The state school capital construction funder, BEST, has several climate resilience/future heat considerations built in through regularized processes. BEST uses construction guidelines that are largely based on code, so as code improves so does the efficiency of BEST funded projects. BEST grantees must adhere to the High Performance Certification Program (administered by OSA). BEST is seeing an increase in HVAC projects compared to the early years of the program and similarly supports storm shelters where appropriate.
CDLE Office of the Future of Work	**Climate impact considerations on the Future of work project:** The Climate Preparedness Office partnering with the Office of Future Work at CDLE are pursuing a research project to better understand the impacts of climate change on Colorado's workforce, research commonly used strategies/policies in other states, and develop easily deployable materials for employees and employers in multiple languages.
CDE BEST, CRO	**Working with the CRO, BEST will evaluate developing a resiliency guide for applicants**, similar to a currently used 'security guide' that is not required but helps the applicant walk through certain questions and considerations that will strengthen their application from a climate readiness perspective.
CDE BEST, DOLA, OSA	**Increase adaptation/resilience standards with the High Performance Certification Program:** BEST grantees must adhere to the High Performance Certification Program (administered by OSA and DOLA). This includes LEED certification standards for energy efficiency, which has co-benefits for protecting against wildfire smoke or external pollution as well as wildfire. The state will evaluate options to strengthen climate adaptation considerations within this program.

Department of Local Affairs (DOLA)	
Background and Ongoing:	The Department of Local Affairs plays a key role in long-term community resilience and disaster recovery through the Division of Local Government (DLG) and the Division of Housing (DOH). The Colorado Resiliency Office, within the DLG, is a key partner in climate adaptation and preparedness, and leads statewide and state interagency efforts to increase resilience across multiple areas of consideration within state agency planning and in particular supporting local government action. The CRO supports coordination across state agencies through the Colorado Resiliency Working Group. In the event of a major disaster, the CRO also leads the Community and Economic Development Recovery Support Function (RSF), and the DOH is lead for the Housing Recovery Support Function (RSF). Immediately following a disaster, the Regional Managers in the DLG are on the ground assisting local governments in needs assessments, capacity, and helping local governments make that transition from response to recovery. This can include Technical Assistance from the DLG's Community Development Office or CRO or identifying capacity and planning resources. The Disaster Resilient Rebuilding Program was established within DLG to support local recovery efforts after state-declared disasters. Due to the large amount of housing damages, these funds have been earmarked for the Housing Recovery Program to assist in the resilient reconstruction of homes lost or damaged in state-declared disasters, including the devastating 2021 Marshall Fire.
CRO, Colorado Resiliency Working Group	**Work across State agencies to develop a Climate Resilient Colorado Program:** Develop a 'one-stop-shop' climate action tool, with consolidated resources and detailed actions, for local governments. CRO will work to develop an associated recognition program and identify funding incentives for local governments achieving key climate actions. This advances the Colorado Resiliency Framework (CRF) strategy (OA1) to develop and manage a program for communities to take concrete steps to improve their resilience and sustainability performance in coordination with CEO and engagement across state agencies. As a first step, CEO and CRO have secured resources to scope and develop the program, including the creation of the local government climate action tool.
CRO	**Integrate, identify, and coordinate across resilience funding sources:** Advance the CRF strategy (OA2) to integrate more resiliency criteria into state competitive grant programs and investments and streamline and align state funding opportunities for local governments and communities. Partner with CPO and the Fed Funds team to grow a network to promote and coordinate strategically on and secure additional resources and investment to implement resilient solutions.

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CRO, CEO	**Expand grid resilience planning and implementation:** CRO will work with CEO to evaluate and prioritize grid resilience efforts through the Colorado Microgrids Roadmap as directed in (HB22-1249), which will be released in January 2025 and will include recommendations. The CRO will continue to manage and expand the Microgrids for Community Resilience program; the program's one-time funding (established by HB22-1013) has been used to leverage more than $17.2M in federal funds for grid resilience.
CRO, CDPHE, CPO	**Extreme heat preparedness planning:** CRO will partner with CDPHE, CPO, and across agencies on the development of a statewide "long-term coordinated strategy for the state's multi-agency extreme heat work" as noted in the CPO and CDPHE actions. Areas where DOLA will be well suited to lead within the strategy include: 1) provide planning and technical assistance resources to local governments to plan and prepare for extreme heat, 2) support projects that enhance grid resilience and preparation for extreme heat events (in partnership with CEO, CDPHE and DORA), and 3) promote community resilience hubs.
DOLA, DLG	**Coordination to enhance the Disaster Resilience Recovery (DRR) program:** The DRR program established in SB22-206 continues to serve as a valuable gap source of funding, particularly given lengthy federal recovery programs, and overall has helped expedite processes by as much as six months. Given the potential need and the effectiveness of the program, the agency is working with DHSEM to identify opportunities to scale up the DRR program and increase already available funding sources with the goal of making recovery resources available within 120 days after a state-declared disaster.
DOLA (DLG, DOH)	**Utilize defined disaster recovery support and planning capacity:** Following legislative approval last year, the Department is hiring two new positions to provide permanent capacity covering Recovery Support Functions (RSF's) previously done ad-hoc which led to delays: one to lead the Community and Economic Recovery RSF and the other to lead the Housing RSF. These positions will facilitate quicker community engagement, needs assessments, and recovery program implementations. During "blue sky" days between major disasters, these positions will work closely at the regional, county, and municipality level to assist in the implementation of pre-disaster planning.
DOLA, DLG, DHSEM	**Enhancing the CrisisTrack system:** As an outgrowth of SB22-206, the existing CrisisTrack system is being funded for all counties and expanded to include a portal for disaster survivors. This portal will allow disaster survivors to annotate their losses and pre-register for disaster assistance. Simultaneously, DOLA is exploring business requirements for a grant system that can handle the complexities of federal funding and incorporates all of the necessary elements of a customer management system, construction management, financial management, and compliance requirements.
CPO, Multiagency	**Advocate for better federal recovery processes - especially for Colorado:** The current landscape of disaster recovery at the federal level remains disjointed, cumbersome, and often too slow to provide the information and resources needed at the household and community level. Western and Colorado-specific circumstances are often not well accounted for. The state will continue to advocate for changes to federal disaster recovery processes, specifically working with national partners through the Council of State Community Development Agencies (COSCDA) on the passage of the Reforming Disaster Recovery Act (S.1686). Permanent reforms to rebuild more resilient and climate ready, rather than simply rebuilding to base standards, are particularly important. Federal agencies are actively evaluating these questions, and state advocacy and partnerships are valuable in shaping future federal decisions.
DOLA, CEO	**Ensure resilience and adaptation elements are well represented in DOLA model codes/guides:** Model building and land use codes incorporate existing best practices on fire, energy efficiency, home hardening, extreme heat, etc. DOLA will re-evaluate additional resilience and adaptation elements for these model codes continuing in future updates. DOLA will also pursue other opportunities for model guidance and resource documents such as HOA guides and model guidelines.
CDO, CRO	**Promote and incentivize strategies to reduce risks to hazards (pointing local governments to planning for hazards guide):** Certain communities have adopted resilience plans, but the agency will work for greater integration of resilience into plans, adoption of resilience plans, and evaluate opportunities to provide assistance to support adoption, as well as incentives in future funding opportunities.
CDO	**Grow collaboration on comprehensive plan and other planning technical assistance and presentations:** DOLA will identify opportunities to bring in additional partners to trainings and presentations to local planners, planning commissions, and elected officials with respect to comp plans and related land use plans, policies, and regulations that can provide added insight on wildfire, water adequacy and conservation planning, biodiversity, or other risk or adaptation factors to consider.

Colorado Department of Public Health and Environment (CDPHE)	
Background and Ongoing:	The Colorado Department of Health and Environment (CDPHE) is prioritizing actions on extreme heat with a focus on public health readiness and response for Colorado's vulnerable populations and disproportionately impacted communities, including mental and behavioral health considerations. CDPHE is participating in the Interagency Extreme Heat Workgroup and formed an internal CDPHE Extreme Heat Workgroup to coordinate and advance key actions, including expanding data surveillance on heat-related illness. The agency is advancing extreme heat and health resources and planning by developing the Extreme Heat Response Plan 2023 for Colorado's long-term care facilities and Access and Functional Needs (AFN) populations. Looking ahead, the agency will develop a public health Heat Action Plan to respond to the presence of an extreme heat event in Colorado communities and prevent morbidity and mortality related to extreme heat. CDPHE recognizes that many communities that face disproportionate impacts from climate change also face greater environmental health risks and may experience cumulative pollution and climate impacts. CDPHE established an Environmental Justice Program and developed the Colorado EnviroScreen tool, which provides a state-of-the-art dataset for identifying communities experiencing disproportionate environmental health risks.
CDPHE Extreme Heat Workgroup	**CDPHE will continue to conduct statewide heat-related illness data improvements and maintain the Heat-related Illness Data Dashboard and monitor the Heat-Related EMS Activations Data Dashboard.** CDPHE will improve heat-related illness surveillance by adding more demographic data and incorporating syndromic data to improve timeliness of surveillance. CDPHE will seek capacity for public health data surveillance and reporting for occupational heat-related illness and education and promotion of best practices for occupational protections from heat-related illness.
CDPHE Extreme Heat Workgroup	**CDPHE will develop a draft public health Heat Action Plan to respond to the presence of an extreme heat event in Colorado communities and prevent morbidity and mortality related to extreme heat.** The agency will be particularly cognizant of mental and behavioral health considerations, care facilities, the state's aging population, and other vulnerable populations.
CDPHE Extreme Heat Workgroup	**CDPHE will pursue opportunities to provide education and resources to the public and health care providers:** It is clear that additional public education is needed, as through public education campaigns, and CDPHE will be evaluating opportunities within existing channels, as well as identifying additional needs for effective public education and messaging. CDPHE will develop a free online course for health care providers on developing heat plans.
CDPHE Extreme Heat Workgroup	**Improve the climate-related security of health care facilities and systems:** CDPHE will work with emergency managers, hospitals, and long-term care facilities to prepare for heat-associated grid strain.
CDPHE Extreme Heat Workgroup	**Disseminate public information about community cooling centers:** Pursue technical assistance, resources, and partnerships to support increasing the number of community cooling centers: Provide best-practice information for opening community cooling centers/resilience hubs and explore opportunities to leverage public-private partnerships for access to cool spaces.
CDPHE Extreme Heat Workgroup	**Integrate extreme heat into the State Health Improvement Plan update:** Pursue opportunities to integrate extreme heat strategies in the 2025-2029 State Health Improvement Plan.
CDPHE Extreme Heat Workgroup	**Partner across agencies to provide technical assistance for and coordination with local governments:** CDPHE will continue to partner with DOLA CRO and across agencies to provide frameworks, plans, and other technical assistance to support local governments, health agencies, and other partners in prioritizing extreme heat actions. CDPHE will also leverage grant funding from the Centers for Disease Control and Prevention (2024-2027) to build public health's capacity for addressing the climate-related health impacts of extreme heat. This will include providing technical assistance to local public health agencies to inform local action plans.
PSD	**Support heat and adaptation public health outcomes in the built environment:** To help Colorado communities adapt to increasing heat, CDPHE will provide technical assistance and support to state agencies and local public health agencies to implement built environment strategies designed for multiple health benefits.
APCD	**Expand work to build resilience/adaptation into the GHG regulatory proposal process:** The state's GHG Pollution Reduction Roadmap features six Climate Equity Principles, including "Building Resilience," which states that "GHG reduction strategies should improve resilience and quality of life for disproportionately impacted communities." Staff will gather expert input from state partners on ways to enhance community resilience benefits in GHG reduction rules and include consideration of resilience and adaptation measures within the rulemaking process.
EJP	CDPHE will work to **incorporate climate adaptation oriented projects and future climate impact analyses into processes for evaluating the use of settlement and grant funding** to carry out projects with long-term and co-benefits, where appropriate given the individual case. An existing example of this that should be built on is the use of settlement funding for an urban tree canopy grant.

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EJP	**Work with partner agencies to increase the utilization of the Environmental Justice Advisory Board as a resource** for recommendations about the intersection of climate change impacts and disproportionately impacted communities. The department will work to utilize the expertise of the Advisory Board on the question of extreme heat impacts and opportunities through an environmental justice lens.
EJP	**Increase coordination across agencies on using Colorado EnviroScreen for technical assistance purposes, and as a tool for local communities:** Specifically, utilize Colorado EnviroScreen and other relevant resources to administer Colorado State Forest Service urban tree canopy grants funded by the federal Justice40 initiative.
EJP	**Increase capacity and resources for environmental justice outcomes:** Communities that face disproportionate impacts from climate change may face greater environmental health burdens and potential cumulative pollution and climate impacts. The governor's budget includes $5.1M to advance environmental justice through the work of the Environmental Justice Program, the Environmental Justice Grant Program, and by prioritizing air, water, and hazardous waste enforcement and compliance initiatives in disproportionately impacted communities.
EP	**Continue to strengthen Colorado EnviroScreen:** Colorado EnviroScreen is a nation-leading tool to visualize environmental health burdens and identify disproportionately impacted communities. The tool continues to be updated to reflect the best available science and data. As future iterations are developed, best available data and science will be updated, and the tool may add climate science scenarios and modeling as an informational resource.
WQCD	**Encouraging and funding regionalization when feasible to lower barriers of access and increase equity with state water infrastructure funding:** The State Revolving Fund program is working to increasingly encourage and promote consolidation and regionalization projects. Additionally, disproportionately impacted communities are eligible for planning and design grants that may help to fund regionalization planning evaluations. The State Revolving Fund has funded a number of projects that include consolidation and regionalization.
WQCD	**Encourage planning for climate change and resiliency against associated hazards, including better securing water supplies:** The State Revolving Fund program includes a green project reserve program for wastewater projects. Many of these projects can provide resilience against climate change by reducing energy consumption or saving water in the event of increasing drought conditions. The program provides incentives such as a reduced interest rate for loans that fund green projects. Furthermore, the State Revolving Fund program is working with a number of projects to secure redundant and resilient water supplies.
WQCD, DNR	**Pursue needed protections for wetlands and water resources:** In the wake of the recent Supreme Court decision regarding regulatory authorities associated with the federal Clean Water Act, the state, as noted in the governor's 2024/25 budget, will pursue state-level actions to ensure Colorado's water resources are adequately protected.

Colorado Department of Transportation (CDOT)	
Background and Ongoing:	The Colorado Department of Transportation has long had a process for baking in resilience and adaptation measures into their work through Policy Directive 1905.0 — "Building Resilience into Transportation Infrastructure and Operations," and CDOT's Risk and Resilience Tool. In addition, the Colorado Department of Transportation Resilience Program considers and invests in the resilience of the assets themselves (e.g., the design and maintenance of bridges to withstand rare, yet catastrophic flood events), or adaptability of CDOT's operations, maintenance, and planning in the face of stressors or challenges. CDOT Climate study completed in 2021: This study evaluated the impact of climate change-induced weather patterns and extreme weather events on geologic hazards (geohazards). The initial step was performing a climate change assessment to identify expected weather patterns and extreme weather events that are a result of climate change. With the information provided by the climate change assessment, CDOT then evaluated how geohazard Frequency and Magnitude (FM) could be affected. This work has informed CDOT planning.
CDOT	**Wildlife crossings are a key infrastructure component of adaptation**, promoting connectivity and resilience in the ability for species to migrate with habitat as the climate changes. The state has created and funded a fund to provide matching grants for the full buildout of the state's 10-year wildlife crossing vision. The agency will continue to pursue federal funding opportunities to achieve this full buildout.
CDOT	**CDOT is evaluating the details of specific points of failure along major state arteries**, such as Glenwood Canyon, affected by compound disasters such as flood and mudslide post wildfire. They will be completing a report outlining these details for certain locations, and this report will help guide near-term action to address this challenge.
CDOT	**CDOT is continuing to provide housing for employees in mountain communities** where their services are needed, including snowplow drivers, to address the inability to hire and retain workers due to challenges with housing affordability and availability. This is an important long-term adaptation strategy as impacts from extreme weather and flood/fire will continue in mountain regions where staffing has been impacted by high-housing costs. CDOT is looking to expand these efforts and build off successes from these pilot programs.
CDOT	**CDOT is beginning to scope its next 10-year surface transportation plan update. With this update they will have an even stronger focus on adaptation/resilience.** The commission is actively approving resilience-centered planning and projects which the agency will be carrying out in the coming years. As one example, the commission's late summer package of nearly $200 million was almost fully resilience oriented. CDOT is investing heavily in resilience and will continue to hold amongst its priorities.
CDOT	**Complete and connected streets:** This action would include implementing key steps to improve bicycle and pedestrian facilities, particularly along and across major arterial roads in Colorado's urban areas. This would include updating the Bicycle and Pedestrian Plan for Colorado, as well as funding and implementing network connectivity improvements along major arterial roadways. (Item independently being considered in GHG Pollution Reduction Roadmap 2.0 process.)
CDOT	**Transit service expansion and implementation, including Front Range Rail:** This action would include expanding Colorado's transit service. This would include implementing Front Range Passenger Rail and new bus rapid transit routes. This could be accomplished through such pathways as legislative or administrative efforts to raise additional funding for more transit service, which could include use of toll revenues to support transit operations and may include investments in increased frequency or quality of service on existing routes and/or investments in new routes statewide. (Item independently being considered in GHG Pollution Reduction Roadmap 2.0 process.)
CDOT	**Expanded Fare Free Transit Program:** This action would include extending and potentially expanding the state's existing zero-fare transit program. SB22-180 created the Ozone Season Transit Grant Program. This program has multiple co-benefits, including increased access to public cooling spaces. (Item independently being considered in GHG Pollution Reduction Roadmap 2.0 process.)

Colorado Department of Public Safety (DPS)	
Background and Ongoing	The Division of Homeland Security and Emergency Management (DHSEM) in the Department of Public Safety (DPS) leads all phases of emergency management in the State, in coordination with local governments and partners. This includes prevention, mitigation, preparedness, response, and recovery. DHSEM also manages the State's Disaster Emergency Fund, federal recovery programs including but not limited to FEMA Individual Assistance, FEMA Public Assistance, and FEMA Sheltering and Services programs. DHSEM helps communities, special districts, and state agencies reduce their long-term risks from natural hazards before and after disasters through FEMA's Hazard Mitigation Assistance and Public Assistance Programs. These projects range in scale from planning, design and engineering, protection for homes and businesses, and large infrastructure and utilities protection projects. These projects anticipate and address the impacts of climate change and other future conditions in their design. The Division of Fire Prevention and Control (DFPC) administers numerous programs related to wildfire preparedness and resilience in addition to resources related to fire suppression. Information about the agencies existing activities can be found here: https://dfpc.colorado.gov/sections/wildfire-information-resource-center The state has made recent significant investments and passed legislation in wildfire preparedness. Background information about many of those recent actions can be found here: https://cdn.colorado.gov/governor/news/10081-continuing-prepare-prevent-respond-wildfires-governor-polis-signs-bills-law and here: https://cdn.colorado.gov/governor/news/8146-making-colorado-communities-safer-healthier-governor-polis-signs-legislation-fight-clean
DHSEM	**Natural Hazard Mitigation Planning:** DHSEM updated the Enhanced-State Hazard Mitigation Plan for 2023 that accounts for the impacts of climate change on disaster risk, informing the planning for hazard mitigation for state and local assets across the state. This planning process brought together agencies across the state to assess hazards to state owned infrastructure. This serves as a valuable resource for this climate preparedness roadmap, and increasingly for local governments. DHSEM will continue to provide assistance to communities to include the impacts of climate change on disaster risk in their county and municipal hazard mitigation plans.
DHSEM	**Administer federal recovery programs including but not limited to FEMA Individual Assistance, FEMA Public Assistance, and FEMA Sheltering and Services program:** The DHSEM is currently managing over $2.4 billion in grant funding through these programs. These programs provide critical funding for local organizations as they recover. Full disbursement of this funding is a priority and expected to last at least the next four years.
DHSEM, DOLA-DLG	**Pursue 'On-call' recovery contracts/retainers:** In the event of a major disaster that extends beyond the state's current capabilities, the time needed for the procurement process can slow recovery efforts. The State has some contracts in place for major needs such as debris removal. However, those items are limited and do not extend into additional capacity in all areas of recovery. DOLA will work with DHSEM on possibly coordinating and expanding existing contracts. (referred to sometimes as 'retainers' or zero-dollar contracts) or DOLA will use DHSEM as a model to develop zero-dollar contracts specifically for recovery needs. These types of contracts were valuable and deployed by Boulder County after the Marshall Fire, but should be available to less-resourced communities and thus a state activity.
DFPC	**Increase safety in the built environment within the wildland urban interface:** DFPC has been working to stand up the newly formed Wildfire Resilience Codes Board. The board will begin work to establish WUI building codes, with base statewide parameters that will allow for the state to increase federal BRIC grant eligibility, while also pursuing nuanced and detailed geographically specific code recommendations in consultation with local communities. The agency will partner with other state agencies and external expertise to ensure the highest level of technical input and available resources for the board. The agency is also working to implement HB23-1273 and is working to acquire additional federal funding for this program, which aims to provide direct funding to home hardening and similar efforts.
DFPC	**Increase cross-agency coordination to meet lengthening fire season:** The 2020 wildfire year makes clear that wildfire season is no longer a season but a threat all year round. Furthermore, we saw from 2020 that early wet springs, which may suggest normal or below normal wildfire risk, can easily lead to significant fire seasons should conditions dry out after fuels have grown fast from a wet spring. Furthermore, climate models show fall to be the fastest warming season, making the late season threat all the more important. With this in mind, the agency will evaluate the best method for increasing the annual wildfire conditions briefing in frequency and adjust or add to the schedule, particularly in the late summer and fall.
DFPC	**Increase partnerships for integration of best available science and data considerations for upcoming five year planning process:** The 2018 DFPC Strategic Plan for Supporting Colorado's Fire Agencies has achieved nearly all of its sought after action items and the agency will begin to develop its next five year plan in the coming year. The agency will work to bring in the best available science and data to inform development of the plan, including through consultation and partnerships with entities like the Colorado State Forest Service and researchers and experts who can support better understandings of climate models and other associated areas.

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DFPC	**Normalize opportunities to move away from seasonal staffing:** With fire seasons shifting, the traditional staffing models are not well aligned to the need of either suppression or fuels mitigation work. The shifting seasons provide both new concerns for lengthened fire seasons, but also creating new windows for fuels treatment work, including slash pile burning or prescribed burning as an appropriate tactic later into the shoulder seasons. The agency will continue to pursue opportunities internally to normalize staffing models and increase agency capacity for prescribed fire work in coordination with external partners.
DFPC	**Utilize federal funding to increase dedicated fuels crews and increase capacity for fuels treatment and mitigation projects:** The state will utilize available federal and other external funding sources to increase fuels treatment projects, including the disposal of wildfire mitigation project materials (i.e. slash piles) through the use of prescribed fire and equipment like air curtain burners. The state will work with local, state, and federal partners to increase the staff and workforce to operate this equipment. Furthermore, the agency will seek opportunities to support training at the local level and increase coordination amongst local and state resources.
DFPC	**Increase fire origin/cause investigation and data collection, analysis, and dissemination activities:** SB23-013 created the Fire Origin and Cause Investigation fund that the Division will utilize to provide support to local fire departments in investigating the cause and origin of fires. As outlined in the Division's strategic plan, expanding the Division's Fire Origin and Cause Investigations capabilities to include teams of investigators that are located throughout the state will contribute to the immediate and long-term success of DFPC's Fire Investigations program. Having fire investigators stationed throughout Colorado will improve response times and ensure that DFPC inspectors are adhering to nationally recognized standards. Further, the bill implements a data-driven program to reduce risk and strengthen Colorado's fire response (Colorado Fire Commission Recommendation 21-03) in order to provide data collection, analysis, and dissemination activities to more effectively prevent or mitigate future fires.
DFPC, DNR, CSFS	**Increase partnerships to advance statewide wildfire outcomes:** The state is working to advance partnerships with foundations and other external entities and grow coordination inside and outside of government to realize nation-leading approaches on wildfire. This includes building out a statewide fire dispatch system and state-managed fire dispatch center to improve response and effectiveness for all fire incidents, building in better and more timely intelligence components for better decision-making, pre-positioning resources prior to fires occurring, and fire behavior modeling to determine appropriate resources and tactics. This also means increasingly looking at mitigation and preparation work from a watershed approach and pursuing a more holistic approach in addressing the increasing wildfire and wildland urban interface risks.
DPS/DFPC, CSFS, DNR	**The Colorado State Forest Service, DPS, DNR and others are working together to evaluate opportunities to grow interjurisdictional partnerships to increase efficiency and investment in wildfire mitigation efforts.** While the state is making progress in advancing wildfire mitigation projects through programs like COSWAP and FRWRM, and making progress in prioritization of projects, there are growing needs and opportunities to advance coordination at a landscape scale. These agencies are working with federal land management agencies and local entities to identify opportunities through partnerships, shared stewardship, good neighbor authority, advancing coordination and other opportunities to increase the efficiency of project approvals and scale of mitigation work completed.
DPS	**Partner to expand applicability of key funding sources:** DPS will work to evaluate the application of different sources of funding and allowed activities. For instance, an allowed activity under hazard mitigation is planning, and the agency will work to evaluate strategic partnerships, such as with the U.S. Forest Service, to apply Hazard Mitigation Grant Program funding for strategic planning with federal land managers or community wildfire protection plans for wildfire mitigation efforts.

Department of Corrections (DOC)

Background and Ongoing	The Department of Corrections manages a large diverse built environment system encompassing 19 facilities, that continues to undertake capital improvements over time to meet the challenges posed by climate change, including heat, wildfire, flooding, and other hazards. The DOC has already initiated a pilot analysis of HVAC systems, implemented pilot projects related to efficient heating, cooling and water usage, and is working to partner with energy providers to pursue resilience funding through the Infrastructure Act.
DOC, CPO	**Better understand climate risk and adaptation resources for DOC facilities:** The Department of Corrections in partnership with the Office of Climate Preparedness will pursue an externally supported study and needs assessment with respect to DOC facility resilience and adaptation for key climate hazards. The study will seek to gain a prioritized understanding of key needs and opportunities to best prepare DOC facilities for key climate hazards such as extreme heat. This will allow DOC to better prioritize actions and achieve outcomes that improve the safety and functioning of facilities for both incarcerated people and the DOC workforce.
DOC	**Partner across agencies to ensure the full utilization of the SWIFT program for wildfire suppression and mitigation efforts:** The Department of Corrections will work to ensure a fully functioning SWIFT program. The department will work to ensure its SWIFT program is able to be utilized to the full capacity possible for both fuels treatments and wildland fire fighting.
DOC	**Pursue Energy Performance Contracting (EPC's) to improve efficiency and support adaptation:** The Department of Corrections is pursuing full energy performance contracting to include new heating/cooling systems. The Department has completed five EPC's. The Department will be exploring ground-source heating and cooling options when investing more than $500k in heating and cooling systems.

State Agencies, Offices, and Relevant Acronyms

1. AFN — Access and Functional Needs
2. APCD — Air Pollution Control Division
3. BEST — Building Excellent Schools Today program
4. BLM — U.S. Bureau of Land Management
5. CCIA — Colorado Commision of Indian Affairs
6. CDA — Colorado Department of Agriculture
7. CDE — Colorado Department of Education
8. CEO — Colorado Energy Office
9. CPO — Governor's Office of Climate Preparedness
10. CPW — Colorado Parks and Wildlife
11. CRO — Colorado Resiliency Office
12. CSFS — Colorado State Forest Service
13. CSU — Colorado State University
14. CTO — Colorado Tourism Office
15. CTW — Colorado Department of Transportation
16. DLR — Division of Local Affairs
17. DNR — Department of Natural Resources
18. DOC — Department of Corrections
19. DOH — Division of Housing
20. DOI — Division of Insurance
21. DOLA — Department of Local Affairs
22. DORA — Department of Regulatory Agencies
23. DPA — Department of Personnel and Administration
24. DPS — Department of Public Safety
25. DRP — Disaster Resilience Program
26. DRR — Disaster Resilient Rebuilding Program
27. DWCB — Colorado Water Conservation Board
28. EJP — Environmental Justice Program
29. EP — Environmental Program
30. EMS — Emergency Medical Services
31. FAIR — Fair Access to Insurance Requirements Plan
32. GOCO — Great Outdoors Colorado
33. NSF — National Science Foundation
34. NRCS — USDA Natural Resources Conservation Service
35. OEDIT — Colorado Office of Economic Development and International Trade
36. OREC — Outdoor Recreation Industry Office
37. OSPB — Governor's Office of State Planning and Budgeting
38. OSA — Office of the State Architect
39. PSD — Prevention Services Division, CDPHE
40. SLB — State Land Board
41. USDA — United States Department of Agriculture
42. WQCD — Water Quality Control Division

Glossary

- **Adaptive Capacity.** Adaptive capacity is the potential or ability of a system, region, or community to adapt to the impacts of climate change. Enhancing adaptive capacity is a practical way of coping with changes and uncertainties in climate, including variability and extremes. Greater adaptive capacity reduces vulnerabilities and promotes sustainable development.
- **Average Annual Loss (AAL).** The expected average monetary loss due to climate events over a one-year period within a specific area or region.
- **Burn Scar.** An area of land charred by wildfire with little or no remaining vegetation, making the ground vulnerable to flash flood, mud, and debris slides.
- **Carbon Sink/Carbon Sequestration.** An area or process that captures and stores carbon dioxide from the atmosphere.
- **Climate Adaptation.** Adaptation is preparing for life in a warmer world. It includes actions taken at the individual, local, regional, and national levels to reduce current risks from the changing climate and to prepare for impacts from future changes. The effects of adaptation work are often felt more acutely at the local level.
- **Climate Impacts.** The consequences of climate-related hazards, exposure, and vulnerability on natural and human systems — specifically the effects on lives, livelihoods, health and well-being, ecosystems and species, economic, social and cultural assets, services, and infrastructure. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial.
- **Climate Mitigation.** Actions that aim to reduce climate change severity, including strategies to reduce emissions or sequester of greenhouse gases.
- **Climate Resilience.** The capacity of interconnected social, economic, and ecological systems to cope with a hazardous event, trend, or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure.
- **Disproportionately Impacted Communities.** Communities that are in a census block group that meet certain criteria as defined by state law. See C.R.S. § 24-4-109(2)(b)(II). Since 2021, the Colorado Department of Public Health and Environment has worked directly with communities affected by climate and environmental injustices to understand disproportionate impacts on their communities and to better refine and define who disproportionately impacted communities are in Colorado. It is paramount to prioritize communities and people — particularly disproportionately impacted communities — in climate adaptation strategies, actions, and opportunities to protect the health and well-being of Coloradans today and in the future.
- **Exposure.** The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely impacted.
- **Extirpation.** Also called local extinction, extirpation describes a situation in which a species or population no longer exists within a certain geographical location.
- **Extreme Heat.** A period of three or more days in Colorado when the temperature is 90 degrees F or higher or multiple consecutive days when the temperature is at least 10 degrees above the average high temperature for the region.
- **Evaporative Demand.** The amount of water that could be transferred from the land surface to the atmosphere.
- **Fire Weather.** The meteorological conditions, such as relative humidity, temperature, and wind, that promote the spread of wildfires.
- **Flash Drought.** The rapid onset or intensification of drought conditions caused by low precipitation, high temperatures, winds, and radiation. These conditions can be influenced by geography and climate patterns.
- **Fluvial Flooding.** Flooding caused by precipitation that causes a river, stream, or other waterway to overflow its banks.
- **Hail.** A form of precipitation consisting of solid ice that forms inside thunderstorms.
- **Hazard.** The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.
- **Hazard Mitigation.** Sustainable action to reduce or eliminate long-term risk to people and property from future disasters.
- **Pluvial Flood.** Flooding caused by excess rainfall in areas where the water cannot be absorbed naturally or carried away quickly enough by the existing infrastructure. Also called flash flooding.
- **Risk.** The potential for adverse impacts for human or ecological systems. Risk results from interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system to the hazards. Hazards, exposure, and vulnerability may each be subject to uncertainty in terms of magnitude and likelihood of occurrence, and each may change over time and space due to socioeconomic changes and human decision-making, changing the risk. Put as an equation, Risk = Hazard x Vulnerability x Exposure.
- **Urban Heat Island Effect.** The measurable increase in ambient air temperature caused by characteristics of the built environment, such heat radiating from concrete or pavement.
- **Vulnerability.** The propensity or predisposition to be adversely affected; sensitivity or susceptibility to harm. Vulnerability is the extent to which people, systems, assets, and other valued entities are limited in their ability to cope and adapt to stressors and hazards.

Appendix

Appendix A:

Figure 3 Detail

This graph, from the forthcoming Climate Change in Colorado Report, illustrates the projected change in Colorado's statewide average annual temperatures up to the year 2100. The projections are shown relative to a baseline period of 1971-2000. These projections are derived from various emissions-scenario models, encompassing two major sets: CMIP5 (Coupled Model Intercomparison Project Phase 5) models, which include both median and range values, and CMIP6 (Coupled Model Intercomparison Project Phase 6) models, featuring only median values. These models are based on medium-low emissions scenarios denoted as RCP4.5 (Representative Concentration Pathway 4.5) and SSP2-4.5 (Shared Socioeconomic Pathway 2-4.5). The graph compares these projections to observed temperatures recorded through 2022. The original data sources include the National Oceanic and Atmospheric Administration (NOAA) NCEI nClimGrid (available at https://www.ncei.noaa.gov/cag/, providing the observed temperature data; CMIP5 data sourced from GDO-DCP (accessible at https://gdo-dcp.ucllnl.org/); and CMIP6 data retrieved from KNMI Climate Explorer (found at https://climexp.knmi.nl). For more detail, please check out the forthcoming report.

Appendix B:

The Climate Risk Assessment Approach

Climate models simulate the climate system, including the atmosphere, oceans, cryosphere, and land, and their interactions, with a focus on long periods of time (decades or longer). Because climate models aim to model the entire climate system, they are typically global in nature. These models are referred to as Global Climate Models (GCMs). The outputs from climate model simulations are analyzed by climate scientists to increase our understanding of how emissions affect the Earth's climate.

Advances in climate models have helped drive climate policy decisions internationally for over five decades. As described by the National Oceanic and Atmospheric Administration (NOAA), "climate models are crucial tools to information decisions of national, regional, and local importance, such as water resource management, agriculture, transportation, and urban planning" (Geophysical Fluid Dynamics Laboratory). Climate models are developed by leading research institutions around the world, with continuous peer review, validation, and refinement.

Scientists combine individual model results, referred to as multi-model ensembles, to account for differences between models' assumptions and architectures to find a meaningful signal from the models' outputs. The scientific community commonly uses the mean result from model ensembles, known as the ensemble mean or multimodel mean, as the representative outcome of the model ensemble. Using model ensembles allows for higher confidence in the results of climate models. The standard model ensembles for the assessment include the following members: NASA-NEX-CMIP6: ACCESS-CM2, ACCESS-ESM1-5, CNRM-ESM2-1, EC-Earth3, IPSL-CM6A-LR, MIROC6, MPI-ESM1-2-HR, MRI-ESM2-0, GFDL-ESM4, NorESM2-MM.

To aid in a more granular understanding of climate change impacts than what is possible based on the resolution of the global climate models (e.g. ~100-200 km for CMIP models), downscaling was used. Downscaling is the process of converting low-resolution information to a higher resolution. This assessment used the statistical downscaling approach, which uses observed data to establish statistical relationships between the global climate models and local climate that results in higher-resolution data. This is a computationally efficient approach that provides a high level of accuracy. For the Climate Risk Assessment, the National Aeronautics and Space Administration Earth Exchange (NASA-NEX) methodology for downscaled climate model ensembles was used.

Future concentrations of emissions and other forces that will impact how the climate may change aren't predictable as they are dependent on decisions that have yet to be made with complex responses and outcomes impacting future population, land use, economic, and emissions trends. Therefore, climate models require consideration of broader socioeconomic factors. These necessary climate scenarios establish sets of assumptions about various socioeconomic factors and the expected level of decarbonization, which will determine the total carbon emissions in the atmosphere in the future and the warming levels at various times. Shared Socioeconomic Pathways are commonly used climate scenarios to account for these assumptions. For the Climate Risk Assessment, SSP 2 and SSP3 are used (see Appendix C for additional information).

The foundation of the Climate Risk Assessment is built on this climate modeling. The climate modeling was then overlaid with flood modeling by Fathom, global hydrological simulations, water basin transfers data, future water withdrawal projections, fire weather index data, Climate Change Initiative Land Cover data, and other peer-reviewed and publicly accepted datasets. This creates scenario analyses of climate hazards relevant to the State of Colorado and tailored to its unique geographical, climatological, and socioeconomic contexts. Layered on top of this foundation are population and demographic projections, socioeconomic projections, disproportionately impacted communities, and natural systems data to assess the risks to people, assets, the economy, and natural and built systems.

Appendix C:

SSP Projected Demographic and GDP Trends and Maps

Shared Socioeconomic Pathways

Climate models require estimates of future concentrations of emissions that require a consideration of broader socioeconomic factors that can affect GHG emissions and land use change. The Shared Socioeconomic Pathways (SSPs) are core building blocks of these scenarios that project what the world's socio-economic state will look like over the next century and inform the global emissions scenarios that drive climate models.

These pathways model how societal actions and choices today could affect greenhouse gas emissions, economics, and demographics. The SSPs define five different pathways the world could follow. The Climate Risk Assessment focuses on SSP2 and SSP3 to ensure diverse population and GDP projections through 2050 are considered for the State of Colorado. While SSP2 reflects a "middle of the road" scenario with historical socioeconomic trends continuing through 2100, SSP3 reflects a "regional rivalry" with changes in the future at the global scale (e.g., low investment in education or health in poorer nations, and growing levels of inequality). The core differences between the scenarios are their assumptions on population growth, urbanization, and economic growth. These projections differ from the projections put out by the State Demographer's Office, which do not incorporate global climate change scenarios.

SSP2: Middle of the Road

Demographic Population Trends

In SSP2, historical trends continuing in the decades ahead result in moderate population growth and ongoing environmental challenges. Under the SSP2 model, Colorado's population is projected to surpass 7 million in 2050, concentrating in urban areas. Maps below show steady growth from 2020 to 2030, with rural areas declining, expected to continue through 2050. This urbanization may raise exposure to climate hazards. This population is also on-trend to age, leading to an imbalance between the wage-earning population and retired population. **See Maps on Page 71.**

Socioeconomic (GDP) Trends — GDP Concentrated in the Front Range, Lower Growth Expected

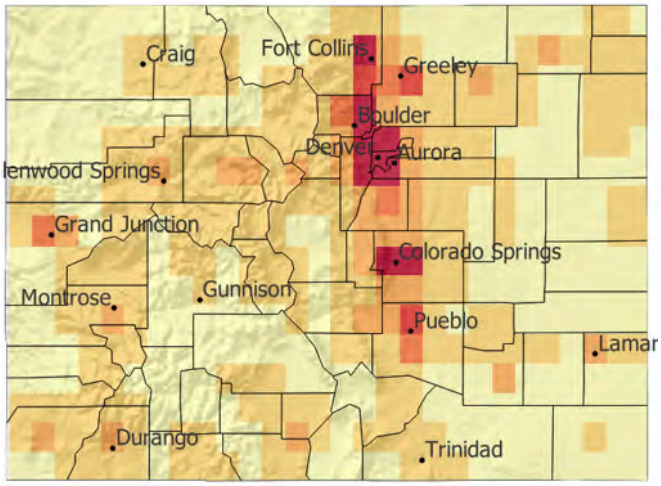
In SSP3, GDP grows from $400 billion in 2020 to an estimated $590 billion by 2050, a slower rate than SSP2. Economic growth in SSP3 remains centered on urban areas, with a discernible decrease in suburban and exurban (communities surrounding suburban areas) growth compared with SSP2. SSP3 also sees lower population growth than SSP2, potentially leading to higher GDP per capita. This suggests a potentially more prosperous population, enhancing economic resilience and resources for adaptation and mitigation against various challenges, including climate-related hazards. **See Maps on Page 72.**

SSP2 Scenario for Population Growth in Colorado 2020-2050

Total population (2020)

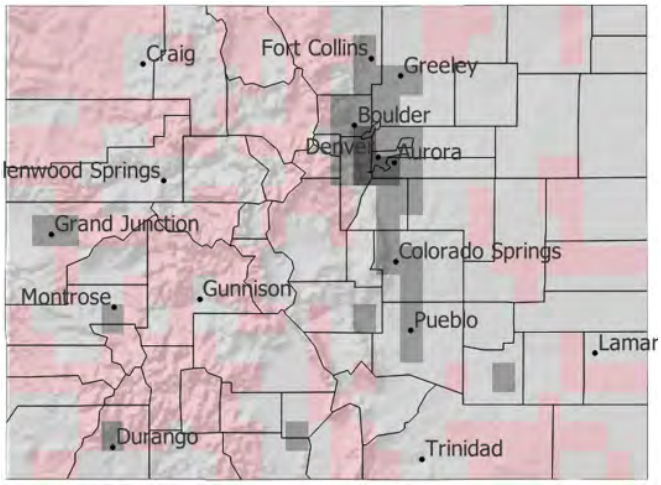
- <=1,000
- 1,000 to 10,000
- 10,000 to 50,000
- 50,000 to 100,000
- 100,000 to 150,000
- > 150,000

Population in 2020



State population in 2020 totaled ~5.8M people and was concentrated in key urban areas such as those in the state's Front Range, reflecting an overall relatively low population density compared with other states.

Change 2020 to 2030

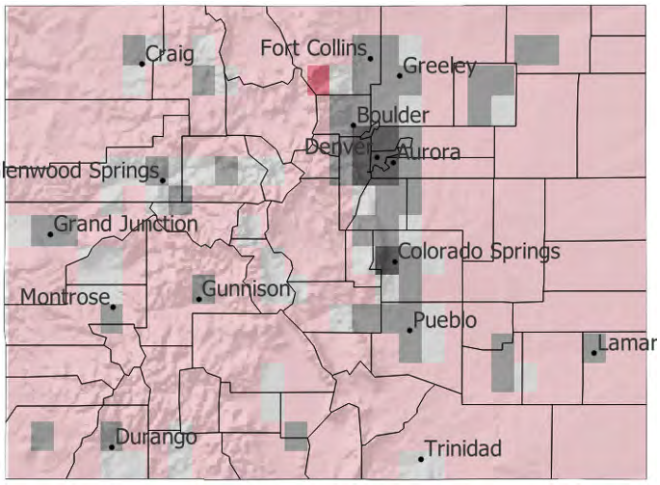


Under SSP2, Colorado's population is projected to grow to ~6.2M in 2030, due to trends such as migration and population aging, spatial concentration around urban areas increases; some rural regions see net population decline.

Population change

- <= -50,000
- -50,000 to -1,000
- -1000 to 0
- 0 to 1,000
- 1,000 to 50,000
- > 50,000

Change 2020 to 2050



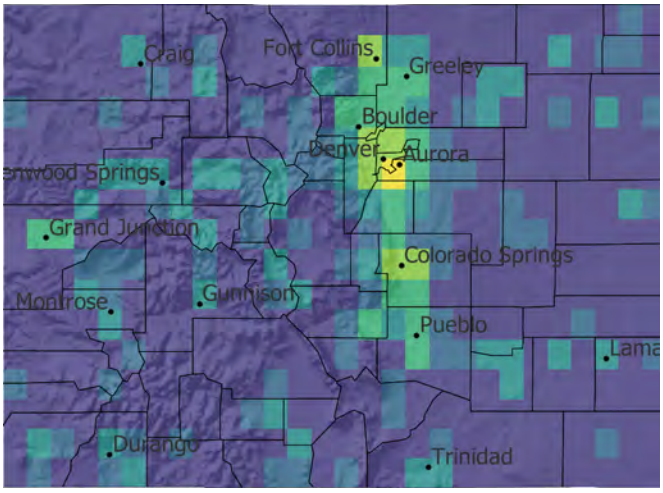
SSP2 projects Colorado's population will grow to ~7M in 2050. Most of the state's population concentrates around the Front Range in urban areas; rural regions experience greater population declines.

SSP2 Scenario for GDP Growth in Colorado 2020-2050

GDP, 2020 ($, USD2020)

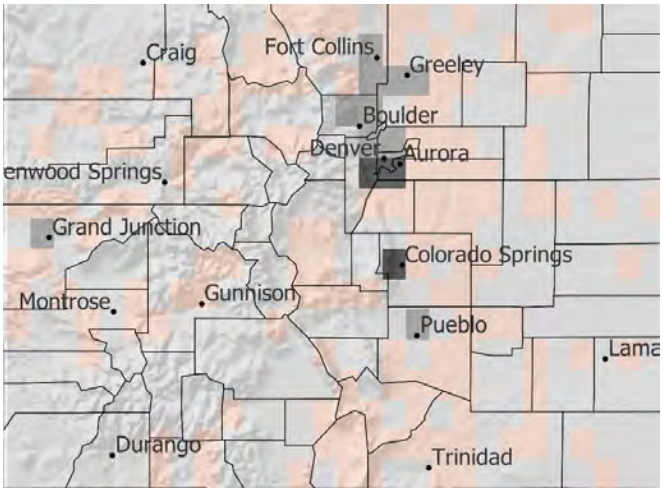
- <= 0.01B
- 0.01B to 0.1B
- 0.1B to 1B
- 1B to 10B
- 10B to 100B
- > 100B

GDP in 2020



In 2020, Colorado's GDP was concentrated around metropolitan areas (primarily disoftributed across the Front Range), with a total value ~$400B (USD2020).

Change 2020 to 2030

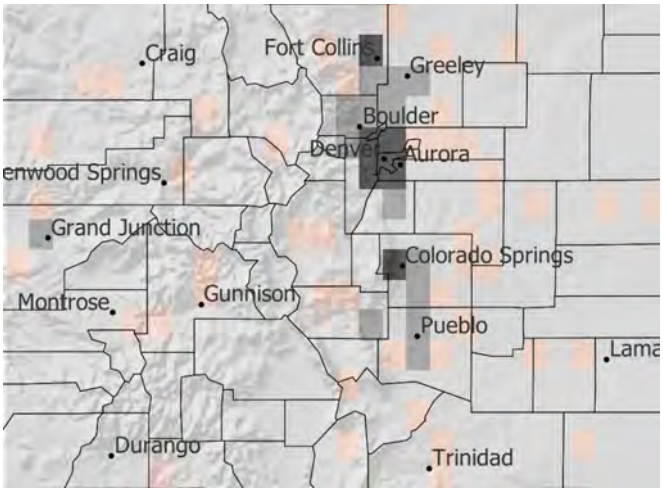


By 2030, Colorado's GDP is projected to grow to ~$480B (USD2020) under SSP2. Most of this growth is concentrated in urban areas and losses are projected in some (mostly rural) areas.

GDP change ($, USD2020)

- <= -10B
- -10B to -1B
- -1B to 0B
- 0B to 1B
- 1B to 10B
- > 10B

Change 2020 to 2050



In 2050, Colorado's GDP is projected to grow to ~$613B (USD2020) under SSP2; economic activity becomes increasingly concentrated.

SSP3: Regional Rivalry — A Rocky Road

Demographic Population Trends

Colorado's population is projected to reach around 6 million people in 2050 in SSP3, marking a significant contrast to SSP2, primarily driven by lower projected fertility rates and a slower pace of urbanization statewide. Like SSP2, the scenario anticipates an increased population concentration in urban areas, with rural areas experiencing a net population decline. The projected increase of the population moving to urban areas similarly heightens exposure to climate hazards as well. **See Maps on Page 74.**

Socioeconomic (GDP) Trends — GDP Concentrated in the Front Range, Lower Growth Expected

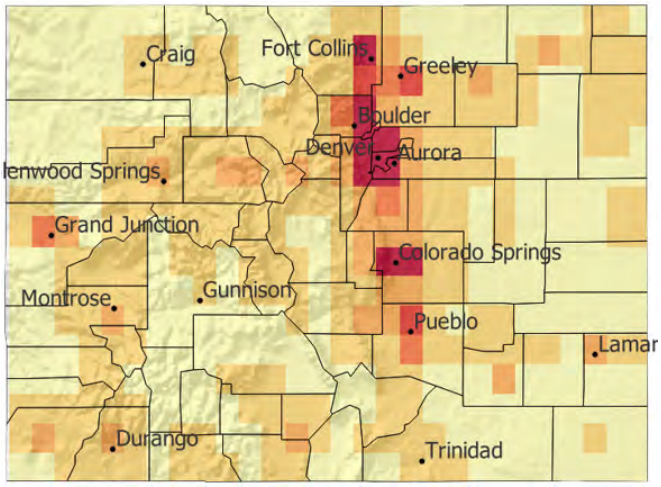
In SSP3, GDP grows from $400 billion in 2020 to an estimated $590 billion by 2050, a slower rate than SSP2. Economic growth in SSP3 remains centered on urban areas, with a discernible decrease in suburban and exurban (communities surrounding suburban areas) growth compared with SSP2. SSP3 also sees lower population growth than SSP2, potentially leading to higher GDP per capita. This suggests a potentially more prosperous population, enhancing economic resilience and resources for adaptation and mitigation against various challenges, including climate-related hazards. **See Maps on Page 75.**

SSP3 Scenario for Population Growth in Colorado 2020-2050

Total population (2020)

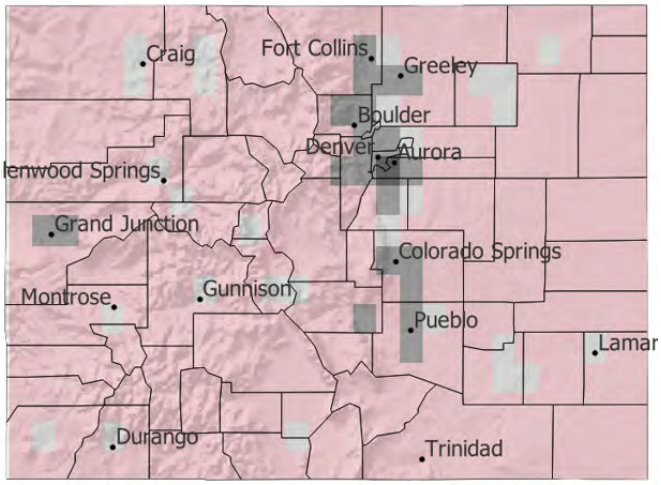
- <=1,000
- 1,000 to 10,000
- 10,000 to 50,000
- 50,000 to 100,000
- 100,000 to 150,000
- > 150,000

Population in 2020



State population in 2020 totaled ~5.8M people and was concentrated in key urban areas such as those in the state's Front Range, reflecting an overall relatively low population density compared with other states.

Change 2020 to 2030

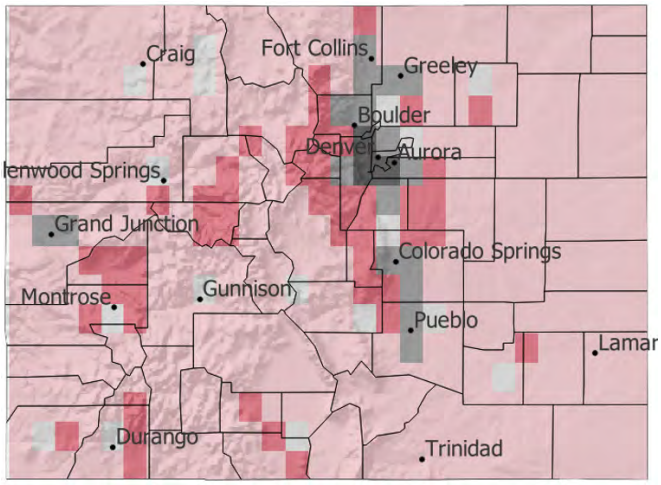


Under SSP3, Colorado's population is projected to grow to ~6M in 2030, due to trends such as migration and population aging, spatial concentration increases around urban areas; rural areas see net population decline.

Population change

- <= -50,000
- -50,000 to -1,000
- -1000 to 0
- 0 to 1,000
- 1,000 to 50,000
- > 50,000

Change 2020 to 2050



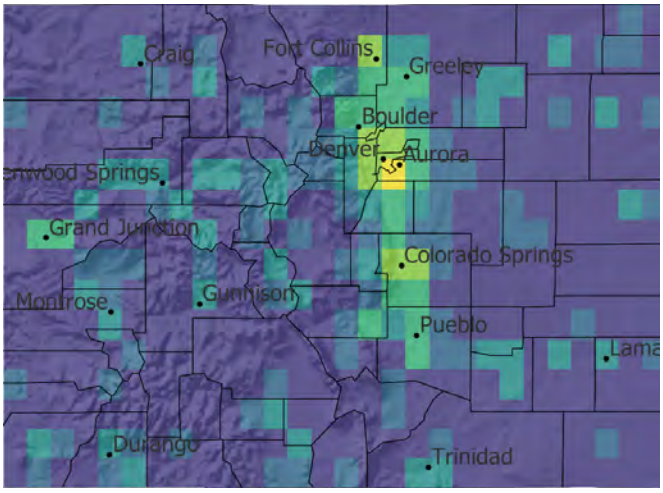
SSP3 projects Colorado's population remains comparable to its 2030 size of ~6M by 2050. Most of the state's population concentrates around the Front Range in urban areas; rural regions experience greater population declines.

SSP3 Scenario for GDP Growth in Colorado 2020-2050

GDP, 2020 ($, USD2020)

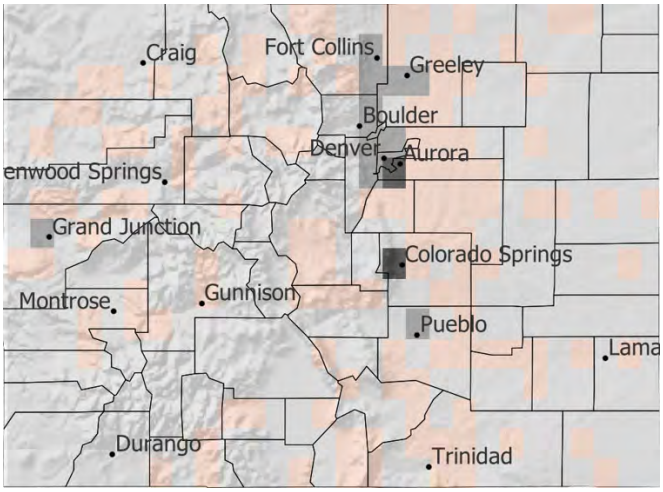
- <= 0.01B
- 0.01B to 0.1B
- 0.1B to 1B
- 1B to 10B
- 10B to 100B
- > 100B

GDP in 2020



In 2020, Colorado's GDP was concentrated around metropolitan areas (primarily distributed across the Front Range), with a total value ~$400B (USD2020).

Change 2020 to 2030

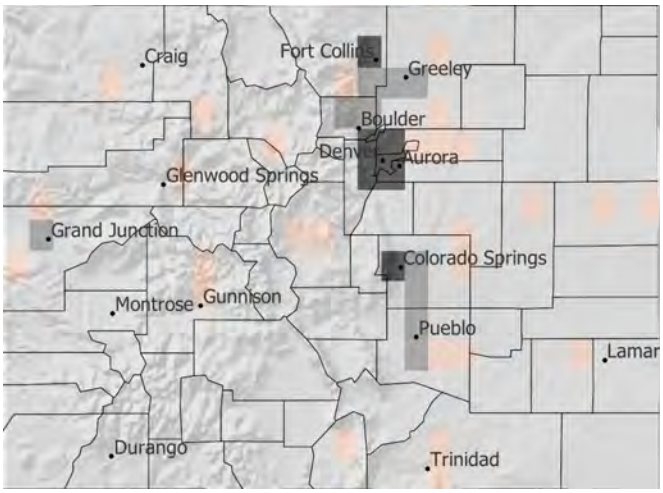


By 2030, Colorado's GDP is projected to grow to ~$470B (USD2020) under SSP3. Most of this growth is concentrated in urban areas and losses are projected in some (mostly rural) areas.

GDP change ($, USD2020)

- <= -10B
- -10B to -1B
- -1B to 0B
- 0B to 1B
- 1B to 10B
- > 10B

Change 2020 to 2050



In 2050, Colorado's GDP is projected to grow to ~$590B (USD2020) under SSP3; economic activity becomes increasingly concentrated in urban areas.

Appendix D:

Engagement

Through extensive engagement and outreach, the Climate Preparedness Roadmap builds on the understandings gained through conversations with citizens and community based organizations, advocacy organizations, researchers and academics, practitioners, and local and federal government partners.

At the outset, the CPO partnered with DEMOS/Helsinki and its non-partisan, non-profit partners at RadicalxChange, Colorado-based Civic Canopy, and Healthy Democracy. This partnership led to the development of a series of three workshops demographically representative of the Colorado population, with particular attention to the inclusion of historically underrepresented peoples. Stipends and selective meeting times were employed to reduce barriers to participation. The workshops used innovative strategies to understand diverse perspectives among participants including use of an online deliberations tool called Pol.is to draw out participant perspectives and find areas of agreement, and quadratic voting to identify participant priorities.

This workshop approach was also used to engage subject matter experts in fields related to natural hazards, climate change preparedness, and adaptation. This approach was paired with targeted conversations in the areas of expertise of the participants, building a deeper, research based, and more nuanced understanding of the challenges and potential solutions within the Colorado specific context.

The CPO later worked with Civic Consulting Collaborative to conduct a broader public and stakeholder engagement effort. To reduce barriers to participation in public engagement sessions and hear from a more diverse cross-section of Coloradans, translation was made available, time commitments were limited to an hour, meetings were conducted via video conference to allow for participation from across the state, and times were selected to provide a range of options including times before, during and after typical work hours. This process provided both topically focused available times, and 'office hour' style times that provided increased flexibility and opportunity for participation.

Through this partnership, 10 public engagement sessions were conducted and twelve two-part stakeholder meetings organized around a broad array of topics and geographic focus areas, with additional opportunities for feedback through asynchronous surveys. This resulted in engagement with over 100 organizations from across the state and engagement with over 150 individuals state-wide. This process resulted in feedback specifically from disproportionately impacted communities, urban, rural, mountain, plains, environmental, non-profit, government, industry, and agricultural communities, among others. The CPO paired this work with one-on-one meetings with stakeholders to gain a deeper understanding in targeted areas of focus.

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