COLORADO'S CLIMATE

TRENDS, IMPACTS, AND MITIGATION EFFORTS (1940-2023)

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Global Climate Change Policies and Analysis

Abstract

This report provides an overview of key climate trends and significant events in Colorado, USA, spanning from 1940 to 2023. It explores the impacts of climate change on the state and highlights Colorado's efforts to mitigate these effects. Additionally, the report reviews the state's energy sources and their role in addressing climate challenges.

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Introduction

Colorado is a relatively large state with diverse geography and diverse weather. Bolinger et al. (2024) asserts that Colorado can be divided into eleven distinct climate divisions. Colorado's climate has experienced many changes and extreme events over the last 80 years and the state is being impacted by anthropogenetic climate change (Bolinger et al., 2024). These changes are negatively impacting Colorado's economy and public health (Colorado Climate Action, 2024 & Esposito, 2017). Like many other areas in the world, to help mitigate global climate change, Colorado is in the process of transitioning from greenhouse gas (GHG) emitting sources of energy, such as coal, to renewables such as solar and wind.

1. Annual Temperature Trends

1.1 Grand Junction and Fort Collins

Colorado's geography is very diverse with mountain ranges, canyons, valleys, high plains, and desert. Geography can impact the weather and result in different areas in the state experiencing different weather trends (Bolinger et al., 2024). Therefore, the average maximum and minimum temperatures were plotted for two cities in Colorado, Grand Junction and Fort Collins between the years 1940 and 2023, (fig. 1). These cities are separated by the Rocky Mountains and are in different climate divisions. Grand Junction is in the Mesas and Valleys division in the central western part of the state and Fort Collins is located just East of the Rocky Mountains in the Northern Front Range division (Bolinger et al., 2024). Note the different temperature trends in these regions, particularly when comparing the average minimum temperatures (fig. 1). Statewide, from 1980 to 2022, annual average temperatures increased by 1.3°C (Bolinger et al., 2024). Simple linear models with temperature as the response and year as the predictor for both regions were created. Models using the maximum temperature showed a significant relationship at the $p = 0.01$ level for both regions, but the minimum temperature was only significant for Fort Collins.

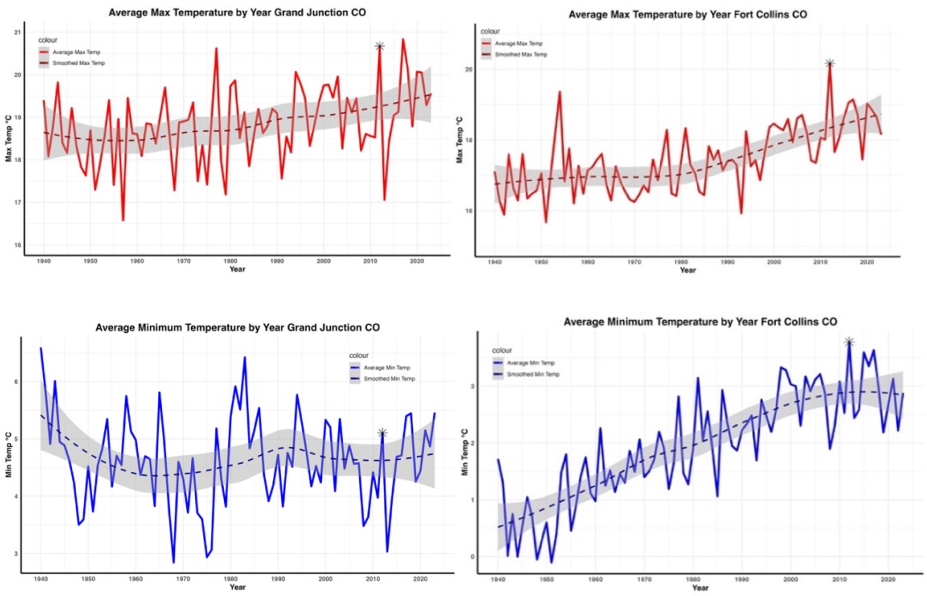

Figure 1: Plots showing the mean annual maximum temperature for Grand Junction on the top left and Fort Collins on the top Right. Plots showing the mean annual minimum temperature for Grand Junction on the bottom left and Fort Collins on the bottom Right. Solid lines represent the mean annual average temperature, the dashed lines resent the loess smoothed data with the shaded area representing the 95% confidence interval. The black asterisk marks the warmest year on record in Colorado, 2012.

1.2 Extreme Temperature Trends

Bolinger et al. (2024) states that in recent decades hotter days and heat waves are becoming more common, and there are fewer cool nights and cold waves across Colorado. This trend appears to be happening in every climate division across the state (Bolinger et al., 2024). To date, 2012 is the hottest year on record in Colorado, marked with an asterisk on the temperature plots in figure 1 (Schumacher, 2024). This century is starting off hot as well. The first three years of the 2020s already experienced more heat waves than any full decade between the 1950s and 1990s for many climate divisions in the state (Schumacher, 2024). This year, 2024, is expected to be the second hottest year on record for Colorado (Schumacher, 2024).

2. Decade-Wise Temperature Changes

Plots for the deviation from the mean maximum and minimum temperatures by decade were created for both Grand Junction and Fort Collins Colorado. Decade wise temperature trends follow a similar pattern as the annual trends. The plots for the maximum temperature show the last two decades as being the warmest in both climate divisions. However, this trend is only true for the minimum temperature for the Fort Collins area.

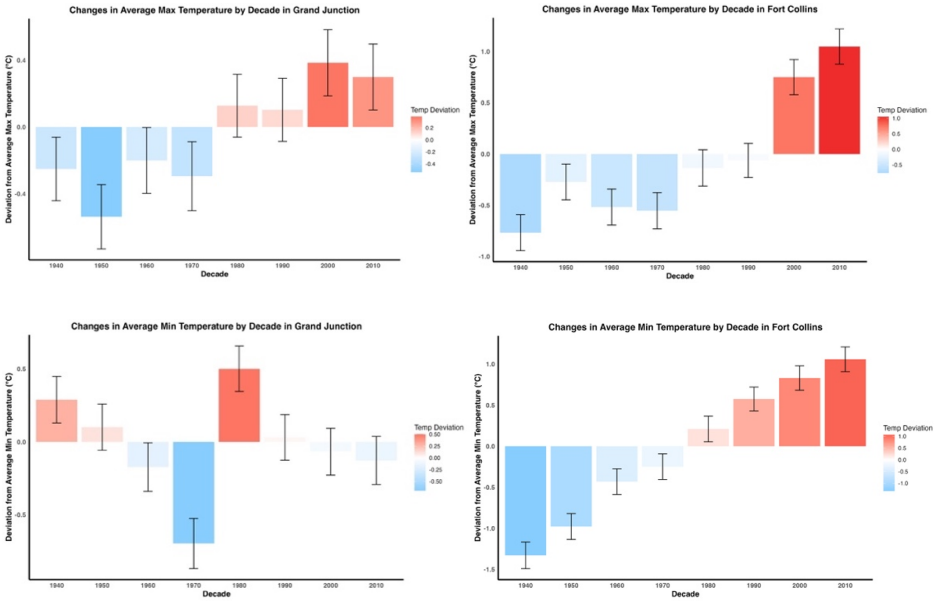

Figure 2: Plots for the deviation from the mean maximum temperature for Grand Junction on the top left and Fort Collins on the top right. Plots for the deviation from the mean minimum temperature for Grand Junction on the bottom left and Fort Collins on the bottom right. Error bars represent the standard error

3. Droughts

3.1. Significant Changes and Trends

Bolinger et al. (2024) notes that Colorado has experienced major droughts in the 1950s, 1960s and 1970s. However, warming temperatures have increased the severity of droughts in Colorado (Bolinger et al., 2024). Due to warming temperatures droughts will continue to increase in severity and frequency regardless of changes in precipitation (Bolinger et al., 2024). There have been four major droughts in Colorado in the 21st century, 2002, 2012, 2018, and 2020 (Bolinger et al., 2024). These years have been marked with a red asterisk on the precipitation and snow plots for Grand

Junction and Fort Collins in figure 3. Notice that 2012 was also the hottest year on record for Colorado. Bolinger et al. (2024) argues that Colorado has been in a drought since 2000 and considers the current drought conditions constitute a megadrought.

3.2. Impacts on Agriculture and Water Resources

According to the U.S. Environmental Protection Agency (2016), droughts result in reduced water levels in rivers and aquifers. This can put pressure on groundwater sources used for irrigation and drinking, further depleting them (U.S. Environmental Protection Agency 2016). Increased drought conditions in Colorado significantly impact agriculture by reducing water availability for irrigation, leading to lower crop yields, decreased livestock productivity, and increasing the potential for crop failures (U.S. Environmental Protection Agency 2016). The economic losses for farmers and ranchers can be substantial, often forcing them to switch to less water-intensive crops or not plant crops at all (U.S. Environmental Protection Agency 2016).

4. Annual Precipitation

Total annual precipitation and total annual snowfall were plotted for Grand Junction and Fort Collins Colorado as well. There are no discernible trends, however major weather events are apparent on some of the plots. There have been four major floods between the years 1940 and 2023 impacting Mesa County, which is the county that Grand Junction Resides (Mesa County, Colorado, 2024). These major flood events happened in the years 1952, 1957, 1983, and 1984, and are marked on the total precipitation and total snow plots for Grand Junction by a dark blue asterisk. There have been two major floods impacting Fort Collins during this time, 1997 and 2013, which are marked with a dark blue asterisk on the plots for Fort Collins (NOAA's National Weather Service, n.d.).

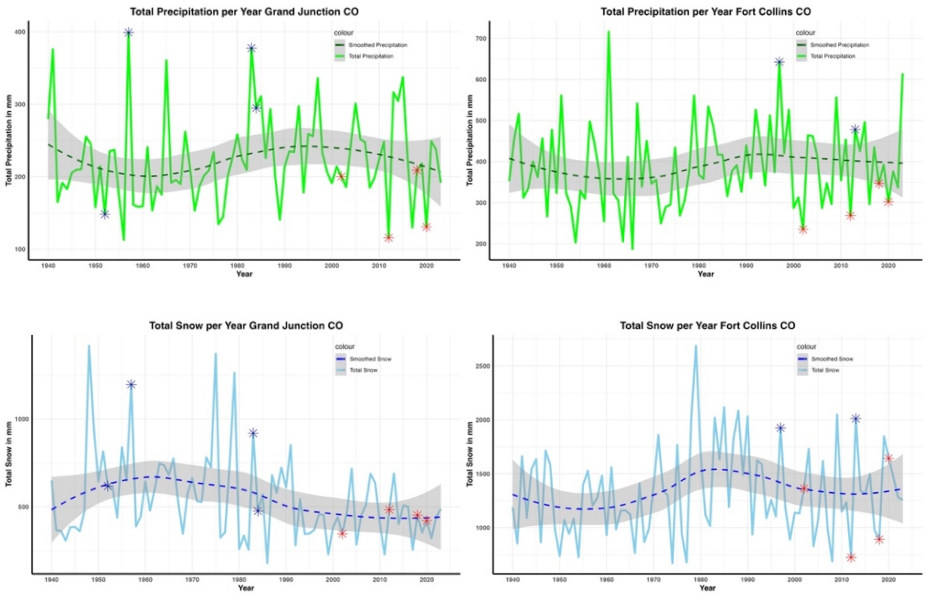

Figure 3: Plots of the total annual precipitation for Grand Junction on the top left and Fort Collins on the top right. Plots of the total annual snow accumulation in Grand Junction on the bottom left and Fort Colins on the bottom right. Solid lines represent the totals, and the dashed lines resent the loess smoothed data with the shaded area representing the 95% confidence interval. Red asterisks are drought years and blue asterisks mark

5. El Niño and La Niña

Although Colorado is a landlocked state, it is not immune from the effects of the oceanic weather patterns of El Niño and La Niña. During El Niño there is an increased probability for higher-than-normal precipitation for most of Colorado and drier than normal conditions during La Niña (NOAA's National Weather Service, 2018). However, because of the diverse geography and weather events in Colorado the impact of El Niño and La Niña can vary across the state. El Niño significantly increases the likelihood of large snowstorms along Colorado's Front Range (Castellani, 2023). In Boulder Colorado, which is in the same climate division as Fort Collins, the El Niño seasons 2018-19 and 2019-20, saw five snowstorms with over 14 inches of snow, while the past five La Niña seasons, 2016-2023 combined produced only seven storms with more than 10 inches (Castellani, 2023). Historical data over more than 75 years shows that 64% of Boulder's largest snowstorms, those exceeding 15 inches, occurred during El Niño events (Castellani, 2023).

6. Impact of Climate Change

6.1. How Climate Change Has Affected Colorado

There are numerous ways that climate change negatively impacts the Colorado, such as a dwindling snowpack, increased risk of wildfires, drought, heat waves, and stress on wildlife (Colorado Climate Action, 2024). Bolinger et al. (2024) asserts that although several factors are contributing to these trends, rising temperatures are a major cause. Across Colorado's river basins snowpack during the 21st century has been 3% to 23% lower than the 1951-2000 average (Bolinger et al., 2024). Since 2000, there has been a large increase in the number of major wildfires in the state (Bolinger et al., 2024). On average, these fires have burned at higher elevations and more intensely than in the 20th century (Bolinger et al., 2024). The severity of droughts in Colorado has increased during the 21st century (Bolinger et al., 2024). Since 2000, annual streamflow in all of Colorado major river basins has been 3% to 19% lower than the 1951-2000 average (Bolinger et al., 2024). There have been significant increases in extreme heat across most of the state (Colorado Climate Action, 2024).

6.2. Evidence of Climate Change

These observed warming trends are strongly linked to human influenced climate change and global warming. The observed warming over the last 20 years is consistent with what was projected by climate models developed in the 2000s (Bolinger et al., 2024). Although there is some evidence that recent increasing trends in extreme rainfall in Colorado is due to climate change, it not consistent across all indicators and time periods (Bolinger et al., 2024). Bolinger et al. (2024) note that atmospheric moisture has increased over Colorado, but not by as much as would be expected from a warming atmosphere alone. Statistical modeling indicates up to half of the observed decrease in streamflow since 1980 in Colorado river basins is due to warming temperatures (Bolinger et al., 2024). Bolinger et al. (2024) describes two studies that link warming temperatures from anthropogenic climate change to half or more of the recent increase in annual area burned from forest fires, and another study that indicates decreased summer precipitation as the primary cause of increased forest fire activity.

7. Representative Concentration Pathways

7.1. In Climate Modelling

Representative Concentration Pathways (RPCs) are scenarios used to model and predict future GHG emissions and concentrations. RPC starts with different levels of GHG atmospheric concentrations in the year 2100 and develops scenarios that achieve those targets. RPC uses a radiative forcing approach, which is a method of classifying different climate change scenarios based on the projected levels of heat retained in the Earth's atmosphere, measured in Watts per square meter (W/m^2) (Jubb et al., n.d. & Murtugudde Climate Academy II, 2023). The four endpoints used in RPC are $2.6W/m^2$, $4.5W/m^2$, $6W/m^2$, and $8.5W/m^2$ (Jubb et al., n.d. & Murtugudde Climate Academy II, 2023). RPC $2.6W/m^2$ is the lowest emissions scenario and RCP $8.5W/m^2$ represents the highest emission scenario, which increases the global average temperatures by 2.4° to 4.8°C by 2100 (ColoradoRiverScience.org, 2023).

7.2. RPC Scenarios in Colorado

Projected climate changes for Colorado and the Southwest U.S. indicate significant increases in extreme heat, precipitation, drought, and wildfire occurrences by mid-century (ColoradoRiverScience.org, 2023). According to ColoradoRiverScience.org (2023) under RPC 8.5 annual temperatures will rise, leading to 20 to 60 more days over 32°C in lower elevations and high-elevation areas experiencing these temperatures for the first time ever. Cold extremes will decrease in frequency, while extreme precipitation events will become more intense and frequent under both PRC 4.5 and RPC 8.5 scenarios (ColoradoRiverScience.org, 2023). The magnitude of extreme precipitation events will increase by 10% under RPC 4.5 and 12% under RPC 8.5 (ColoradoRiverScience.org, 2023). Additionally, wildfires are projected to increase in both frequency and total area burned, exacerbated by rising temperatures, drier conditions and a longer wildfire season (ColoradoRiverScience.org, 2023).

8. Carbon Capture and Storage

8.1. Description and Impacts on Climate Change

Carbon Capture and Storage (CCS) is the process of capturing and storing carbon dioxide (CO_2) produced during power generation and manufacturing so that it is not released into the atmosphere (Gonzales et al., 2020). According to Gonzales et al., (2020), facilities with CCS devices are very efficient and can capture 90 to 100% of the CO_2 they produce. After capturing CO_2, it is compressed into a fluid and injected deep underground in geologically stable locations (Gonzales et al., 2020). Since CO_2 is contributing to global warming capturing it before it enters the atmosphere could help mitigate climate change. However, plans for long-term oversite must be in place to ensure the integrity of storage sites.

8.2. CCS in Colorado

According to the Great Plains Institute (2022), there are 18 economically feasible CCS sites in Colorado with the combined capability to capture 10 million metric tons of CO_2 Annually. The majority of these sites are coal fired power plants (Great Plains Institute, 2022). There are pilot

studies underway investigating several potential CO_2 sequestration sites in the state (Colorado Geological Survey, 2023a).

9. Paris Agreement

9.1. Key Goals

The primary goal of the Paris Agreement is to limit global warming to below 2 degrees Celsius above pre-industrial levels (United Nations, n.d. -a). Desirably the increase will be limited to 1.5 degrees Celsius (United Nations, n.d. -a). Another goal is to strengthen the global response to climate change, because to significantly reduce GHG emissions and keep global warming in check global participation will be needed (United Nations, n.d. -a).

9.2. Colorado's Support

After the United States withdrew from the Paris Agreement in 2017 John Hickenlooper, the Governor of Colorado at the time, signed an executive order mandating that Colorado will join the agreement (Finley, 2017). This included a commitment to cut greenhouse gas emissions 26% by 2025 (Finley, 2017). To help meet this goal, the state would invest in solar and wind energy production and make the state friendlier to electrical vehicles by providing more charging stations (Finley, 2017).

10. Kyoto Protocol

10.1. Overview

The Kyoto Protocol was a commitment by industrialized countries to reduce their greenhouse gas emissions by specific, legally binding targets (United Nations, n.d.-b). With the goal of stabilizing atmospheric GHG concentrations to mitigate the effects of anthropogenic climate change (United Nations, n.d.-b). To achieve this individual emission reduction targets were set for participating countries based on 1990 GHG levels (United Nations, n.d.-b).

10.2. The United States and Colorado

Although the United States Signed the Kyoto Protocol in 1998 it was never ratified by the United States' Congress and therefore it was never officially agreed to by the United States (Clinton Digital Library, n.d.). The Kyoto Protocol is no longer in effect and has been superseded by the Paris Agreement (Clinton Digital Library, n.d.). Since the protocol was never ratified by the United States it had limited impact in Colorado and the rest of the country. However, the Kyoto Protocol did lay the groundwork for the Paris agreement (Clinton Digital Library, n.d.), which, as discussed earlier, had a stronger influence on Colorado's environmental policies and policies throughout the world.

11. Renewable Energy

Renewable sources of energy in Colorado include wind, solar, hydroelectricity and geothermal energy (Colorado Geological Survey, 2023b). In 2004, Colorado voters approved an amendment

to expand sources of renewable energy in the state. In 2010 approximately 68% of the power in Colorado was generated by coal-fired power plants, but by 2023 this number dropped to 32% as coal was being replaced by greener energy sources (U.S. Energy Information Administration, 2024). In 2023 renewable sources accounted for 39% of the energy produced in Colorado, with wind producing 28% of the state's energy (U.S. Energy Information Administration, 2024).

12. Nuclear Energy

Colorado has had only one nuclear power plant that was in service from 1976 to 1989 (Denka & Legislative Council Staff, 2021). According to Denka & Legislative Council Staff (2021) the state currently has no nuclear power plants and there are not any plans to build any in the future. There are uranium deposits in Colorado and uranium was mined from the1950s until 2009 (Denka & Legislative Council Staff, 2021). Although uranium is not currently being mined in Colorado, plans to begin mining uranium in the western part of the state are being considered (U.S. Energy Information Administration, 2024).

13. Nuclear Energy Advisory Committee

13.1. Purpose

The Nuclear Energy Advisory Committee (NEAC) was created to advise the U.S. Department of Energy (DOE) on matters related to nuclear energy (Office of Nuclear Energy, n.d.). NEAC is comprised of a group of energy experts from universities, industry, foreign nationals, and national laboratories (Office of Nuclear Energy, n.d.). NEAC's primary purpose is to assess and offer guidance on various aspects of the DOE's nuclear energy programs, including research and development, energy security, environmental sustainability, and technological innovation (Office of Nuclear Energy, n.d.).

13.2. Influence in Colorado

NEAC's direct influence in Colorado is limited due to the absence of nuclear power plants in the state. However, as there are currently discussions about renewing uranium mining in the state, NEAC could provide advice on safe mining practices, transportation and minimizing environmental impact (U.S. Energy Information Administration, 2024). Also, there are two major highways in Colorado I25 and I70, so NEAC could have an influence in Colorado by implementing policies that affect interstate transportation of nuclear materials.

14. Fracking

14.1. Fracking Explained

Hydraulic fracturing, or fracking is a procedure that creates fractures in rock formations to extract natural gas or oil (U.S. Environmental Protection Agency, 2024). The fractures are created by injecting large amounts of a solution containing water, proppant, such as sand or ceramic pellets, and chemicals into the rock (U.S. Environmental Protection Agency 2024). Eventually the pressure in the rock formation pushes the solution to the surface through the opening (U.S. Environmental Protection Agency 2024).

14.2. Fracking in Colorado

Colorado is the fourth largest oil producing state in the country (Riddick et al., 2024). Fracking is extensively done in Colorado with a large increase in activity starting around 2010 (Colorado School of Public Health, 2020). The Colorado School of Public Health (2020), states that fracking has greatly enhanced oil and natural gas production in the state.

14.3. Environmental Concerns

Water contamination from the chemicals used in the fracking solution is a primary concern with fracking (National Institute of Environmental Health Sciences, n.d.). Since the fracking solution is injected far underground there is a risk of it mixing with sources of drinking water (National Institute of Environmental Health Sciences, n.d.). There are also concerns relate the proper recovery and disposal of the fracking solution (National Institute of Environmental Health Sciences, n.d.). The amount of water used for fracking can become an issue as well, especially during droughts. In Colorado there have been reports of people living and working near fracking wells developing respritory problems (Colorado School of Public Health, 2020). Fracking is also a source of methane emissions, especially from abandoned unplugged wells (Riddick et al., 2024). Riddick et al. (2024) estimates that there are approximately 49,000 plugged and 33,000 unplugged abandoned wells in Colorado.

15. Waste Management

15.1. Energy Industry

Waste from oil and gas production in Colorado is managed by the Colorado Oil and Gas Conservation Commission (COGCC). The oil and gas industry generates different types of waste, including drilling fluids, produced water, which is water that surfaces during oil and gas extraction, and solid waste such as drill cuttings (Colorado Department of Natural Resources, 2020). Waste fluids are injected and stored underground, and non-hazardous solid waste, such as drill cuttings, are disposed of in landfills (Colorado Department of Natural Resources, 2020).

15.2. Agriculture

Agricultural waste is regulated by the Colorado Department of Public Health and Environment (Colorado Department of Public Health and Environment, 2024a). Farms are required to implement strategies to prevent runoff of animal waste into water sources (Colorado Department of Public Health and Environment, 2024a). Discarded or residual plant materials as well as manure is often composted and used as organic fertilizer (Colorado Department of Public Health and Environment, 2024a). Pesticides and fertilizers used in agriculture can be harmful to the environment. The Colorado Department of Agriculture developed a Pesticide Disposal Program to help farmers safely dispose of unused or expired chemicals, preventing contamination of soil and water. (Colorado Department of Agriculture, 2024).

15.3. Mining

Colorado has a long history of mining, dating back to the gold rush of the late 1850s (Colorado Department of Public Health and Environment, 2024b) Mining waste is also regulated by Colorado Department of Public Health and Environment, which requires the use of tailing ponds, water

treatment and land reclamation (Colorado Department of Public Health and Environment, 2024b). Unfortunately, environmental regulations were not enacted in the state until the 1970s and 1980s, resulting in improperly secured legacy mines (Colorado Department of Public Health and Environment, 2024b). Mine drainage from legacy mines releases harmful metals into streams, affecting fish, aquatic ecosystems, drinking water, and agriculture (Colorado Department of Public Health and Environment, 2024b). This creates ongoing challenges in the state, with over 23,000 abandoned mines and 1,800 miles of polluted streams (Colorado Department of Public Health and Environment, 2024b). To address this, the Mine Impacted Streams Task Force was established in 2015 to assess water quality impacts and promote improvements through pollution control projects (Colorado Department of Public Health and Environment, 2024b).

16. Environmental Policies

In 2004 Colorado became the first state to pass legislation creating a renewable portfolio standard (International Energy Agency, 2017). This standard mandated that by 2015 renewable energy would make up 10% of the energy used in the state, and this target was increased to 20% in 2007 (International Energy Agency, 2017). In 2019 Jared Polis, the current governor of Colorado, drafted a plan that would result in 100% of the energy used in the state being from renewable sources by 2040 and expand the use of electric vehicles (Colorado Energy Office, 2024). These policies were bolstered in 2021 when Colorado created the Greenhouse Gas pollution Reduction Roadmap, which provides a solid, science-based framework for achieving these goals (Colorado Energy Office, 2024). Colorado recently adapted bill SB19-181, which augmented the authority of the COGCC to emphasize environmental and public health concerns over oil and gas development (Colorado Department of Natural Resources, 2020). This bill increased the distance oil and gas wells, including fracking sites, can be from residential areas, has stricter protections for drinking water and methane emissions from wells, and other environmental protections (Colorado Department of Natural Resources, 2020).

17. Economic Impact of Climate Change

17.1. Agriculture

Agriculture is an important part of Colorado's economy, and it is being impacted by climate change. As the severity and frequency of droughts increases farming in Colorado becomes more difficult. According to Colorado Climate Action (2024) since 2000 Colorado has experienced four severe droughts and this trend is expected to worsen. Also, as the climate changes there is an increase in dangerous pests feeding on and stressing Colorado's crops (Colorado Climate Action, 2024).

17.2. Outdoor Recreation

Outdoor recreation is another important component to Colorado's economy that is being adversely impacted by climate change. Activities such as hunting, fishing, skiing, and hiking bring many visitors to Colorado each year, and outdoor recreation adds approximately 5% to the state's gross domestic product (The Colorado Outdoor partnership, 2021). Climate change is altering river flows, mountain snowpack, stressing wildlife and endangering the state's forests, which can all negatively impact outdoor recreational activities (Colorado Climate Action, 2024).

17.3. Damage from Extreme Weather

As the severity and frequency of extreme weather events increases so does the potential for damage to property and infrastructure. The U.S. Environmental Protection Agency (2016) notes that as temperatures and drought conditions increase so does the severity, frequency, and extent of wildfires in Colorado. Wildfires can cause severe damage to property, natural resources and infrastructure. For example, in 2013 the Black Forest Fire consumed 14,000 acres of forest and destroyed over 500 homes in Colorado (U.S. Environmental Protection Agency, 2016).

18. Impacts of Climate Change on Public Health

18.1. Heat

Climate change has adverse impacts on public health in Colorado. Extreme heat events can damage individuals' cardiovascular, respiratory, and nervous systems (Colorado Climate Action, 2024). Esposito (2017) states that an increase in the frequency of heat stroke and dehydration accompany an increase in temperature. These health risks are more pronounced in the elderly, children and people with certain pre-existing conditions like diabetes and cardiovascular disease (Esposito, 2017).

18.2. Air Quality

Climate change is also impacting air quality in Colorado. As temperatures rise, the amount of ground level ozone increases, especially during the summer months (Esposito, 2017). Ozone can cause respiratory problems and exacerbates conditions such as asthma and bronchitis (Esposito, 2017). Smoke from wildfires is also contributing to Colorado's air quality problems. Esposito (2017) asserts that wildfire smoke increases the amount of ozone and particulate matter in the air, which contributes to an increased risk of developing lung cancer, cardiovascular disease, and asthma.

18.3. Socio-economic Considerations

According to the Public Health Institute/Center for Climate Change and Health (2016), people living in poverty are more susceptible to the deleterious effects of climate change to their health. This is because they may live in poor housing conditions with poor ventilation, no air conditioning, or are disincentivized to use the air conditioning because of the coast (Public Health Institute/Center for Climate Change and Health, 2016). Also, people experiencing poverty and communities of color are more likely to live in what are known as urban heat islands, which are areas with less green spaces, more buildings, and more energy use resulting in higher temperatures (Public Health Institute/Center for Climate Change and Health, 2016).

19. Personal Action Plan

Colorado voters have taken significant steps to reduce the state's carbon footprint. In 2004, they passed the Renewable Portfolio Standard and have supported environmentally conscious politicians. This has led to strengthening the Renewable Portfolio Standard, which mandates increased use of renewable energy sources, and the passage of key legislation like SB19-181,

which prioritizes public health and environmental protection in oil and gas regulation. This trend must continue in Colorado to lower GHG emissions.

However, while voting for pro-environment policies is crucial, it is not enough on its own. As a Colorado resident, I believe individual actions must also play a larger role in reducing GHG emissions. Outdoor recreation is very popular in Colorado, but unfortunately contributes to fossil fuel consumption, especially during peak travel seasons. For instance, highways leading into the mountains often become congested with cars as people from urban areas like Denver head to ski resorts in the winter. To effectively combat climate change, we must embrace lifestyle changes to help reduce emissions and protect our environment for future generations. This may mean fewer trips to the mountains, increased use of public transportation and dietary changes.

20. Final Reflection and Conclusion

One thing that stood out to me while working on this report was the complexity of climate data and climate change. One reason for this complexity is that although climate change is a global problem, some of the effects are very localized. I was surprised to find that Colorado could be divided into eleven climate divisions, I would have thought there were five or maybe six. Therefore, even areas that are near each other may have different vulnerabilities and could be impacted by climate change differently.

This course did help me gain a deeper understanding of nuclear energy. I did not think of nuclear energy as a green energy solution because of the waste generated and the risk of radiation leaks. However, nuclear power has minimal GHG emissions, is reliable, efficient and requires very little maintenance (Office of Nuclear Energy, 2021). Currently my main concern with nuclear energy is radiation leaks that are human caused, particularly through war. Russia deliberately targeted nuclear power plants and stockpiles of nuclear material in Ukraine, and there are currently concerns that Israel will target nuclear facilities in Iran. There must be strict policies in place protecting and prohibiting the targeting of nuclear facilities if nuclear energy is to be more widely used.

Upon completing this course, I have not changed my views regarding climate change and the policies surrounding it very much. This is a problem that urgently needs attention, and I am very frustrated with the ignorance and inability for some, even prominent world leaders, to understand and accept that climate change is happening and is human caused. It will take a global effort to address climate change, but it will also require regional and cultural awareness.

Data

Data used in this report is from the National Centers for Environmental Information: https://www.ncei.noaa.gov/node/6696

GitHub Repository

https://github.com/grybkom/Colorado_Climate_Analysis

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