Hailey Doucette
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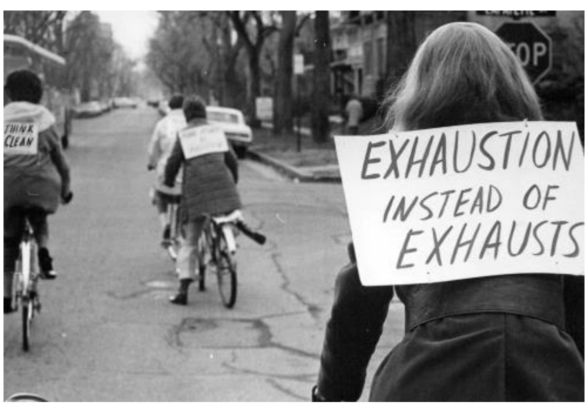
‘The Great Highway Murder Mystery’: Air Pollution in Denver, Colorado 1945 to 2002

On April 22, 1970, Coloradoans joined over twenty million Americans protesting environmental pollution at the first Earth Day. Residents in gas masks with signs endorsing the use of bicycles over automobiles attended a twelve-hour teach-in at Curr igan Hall in Denver. Speakers included Wisconsin Senator Gaylord Nelson, the founder of Earth Day, Denver Mayor William McNicholas, and Colorado Governor John Arthur Love, among two dozen others. Senator Nelson urged citizens to elect an “Ecology Congress,” and proclaimed that “new national policies… will interfere with what many have considered their right to use and abuse the air, the water, the land, just because that is what we have always done.”[1] Paradoxically, while environmental activists listened to Nelson’s speech about cleaning up the planet they littered the floor with cigarette butts, sunflower seeds, and soda cans, trashing the building.[2] Earth Day brought attention to the pollution problem the U.S. faced but it took decades to start reducing it.[3]



Bicyclist mark Earth Day on April 20, 1970, in Denver, Bill Peters, *Denver Post*.

Bicycles Attest to Earth Day Activities, 1970, Rocky Mountain News Photographs, Box 364, Folder Environment- Earth Day.

[1] “Nelson Denver Speech Notes,” Give Earth a Chance: Environmental Activism in Michigan, April 22, 1970.
[2] “1,000 persons attend Sen. Nelson’s on pollution problem,” *Fort Collins Coloradoan*, April 23, 1970.
[3] For more on the idea that population growth could prevent environmental degradation see Paul Sabin, *The Bet: Paul Ehrlich, Julian Simon, and Our Gamble over Earth’s Future*, New Haven: Yale University Press, 2013. For more on Earth Day see Adam Rome, *The Genius of Earth Day: How a 1970 Teach-In Unexpectedly Made the First Green Generation*, New York: Hill and Wage Press, 2013.

In Denver, one of the main problems environmental activists sought to address was air pollution. Colorado suffered from high levels of carbon monoxide emitted from automobiles, which is why some of the more common signs at the Earth Day protests urged drivers to switch to bicycling. As the historian Finis Dunaway argues in *Seeing Green*, the images that the media produced from the modern environmental movement “provoked environmental anxiety but also prescribed limited forms of action.”[4] In Denver, this tendency was on display, with residents biking to the protests but leaving cigarette butts behind. Furthermore, while environmentalists saw a reduction in cars as nearly the only solution to reducing carbon monoxide levels, convincing citizens to give up the accessibility and freedom of driving to work in exchange for biking in Denver’s unpredictable climate was impractical.

Historians have looked to other cities to analyze how air pollution was one of the main issues that unified the nationwide modern environmental movement. In *Don’t Breathe the Air*, Scott Dewey used Los Angeles, New York City, and central Florida as case studies to argue that environmentalism grew out of anxiety that pollution was causing public health crises. Dewey examined how Los Angeles successfully regulated industrial pollution but did not mitigate automobile pollution until the federal government intervened.[5] The same story was true in Denver; however, mitigation there was even slower than in Los Angeles.

Denver provides a distinctive perspective on air pollution mitigation because the city never had any disasters that directly resulted in people dying. For example, in Donora, Pennsylvania in October 1948, 20 people died because meteorologic and geographic factors trapped a polluted airmass over the town. Immediately after this tragedy, the United State Public

[4] Finis Dunaway*, Seeing Green: The Use and Abuse of American Environmental Images* (Chicago: University of Chicago Press, 2015), 8.
[5] Scott Dewey, *Don’t Breathe the Air: Air Pollution and U.S. Environmental Politics, 1945-1970* (College Station: Texas A&M University Press, 2000), 109.

Health Service conducted an extensive study to identify the causes of the event and twenty-first century scientists point to the Donora smog disaster as a catalyst driving the federal government to work towards reducing air pollution.[6] This lack of dramatic incidents in Denver resulted in slower action. Additionally, Denver's high altitude, dry and sunny weather, and location within a river valley worsened air pollution. In Denver, the number one source of air pollution was carbon monoxide emitted from automobiles. But because carbon monoxide was colorless and odorless, many activists ignored this type of pollution until studies proved that it was a threat to public health.

This article explains how Denver's unique environment resulted in cars emitting more pollution than automobiles at lower elevations; to make matters worse, Denver's climate and topography failed to disperse air pollution quickly. At the same time, the number of residents in the Denver Metro Area skyrocketed after World War II, and with more people came more cars, increasing air pollution. In 1945, Colorado had 1,116,000 residents and these Coloradoans registered 271,120 automobiles in the state. By 1960, Colorado's population increased to 1,753,947 people with 714,821 automobile registrations.[7] Furthermore, in 1968, automobiles and other mobile sources emitted 616,000 tons of carbon monoxide in Denver.[8] By the early 1960s, business-linked non-profits started pushing Denver lawmakers to clean up the city's air, fearing that air pollution would cause people to avoid the city and stall economic growth. Then, in the

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[6] Elizabeth T. Jacobs, Jefferey L. Burgess, and Mark B. Abbott, "The Donora Smog Revisited: 70 Years After the Event That Inspired the Clean Air Act," *Am J Public Health* 108 (April 2018), S85-S88.
[7] "Motor Vehicle Registrations, By States, 1900-1995," Federal Highway Administration, pg. 2, https://www.fhwa.dot.gov/ohim/summary95/mv201.pdf. And "Demographic Statistics: Historical Census Population of Colorado 1870—2000," Colorado Department of Transportation, https://dtdapps.coloradodot.info/staticdata/Statistics/dsp_folder/Demographic/HistoricalCensus.htm
[8] Clyde Morita, Guntis Ozolins, and George Duggan, "Denver Air Pollutant Emission Inventory," Department of Health, Education, and Welfare, U.S. Public Health Service, National Air Pollution Control Administration, Air Quality and Emission Data Program, August 1968, pg. 7.

late 1960s, environmental groups emerged in Denver to join the fight against air pollution, and the federal government started passing legislation to mitigate the air pollution crises.

In Denver, most activists and lawmakers prioritized reducing the number of cars on the road but failed to implement strategies that would facilitate a decrease in automobiles. In the end, activists and lawmakers were not successful in cutting the number of cars on the road because they did not devise reasonable incentives for residents to quit driving. However, activists did push the federal government to make strides in reducing air pollution. Events such as Earth Day showcased to the federal government the national desire to clean up the air, influencing lawmakers to pass legislation mandating the use of technologies that would mitigate air pollution. When Denver's air quality finally improved in the 1990s, it was the result of new automobile technology and stricter pollution regulations inspired by environmental activists and introduced by lawmakers in the 1970s, not a reduction in cars on the road.

The Early Days of Auto Pollution, 1945 to 1962

Before the environmental movement coalesced in 1970 at the Earth Day protests, Colorado business groups started to push legislators to study the causes of air pollution to prevent the problem from hampering the growth of Denver.[9] After World War II, Colorado residents and business owners began seeking smoke abatement laws because it was becoming increasingly clear that air pollution impaired the aesthetic views of Denver.[10] Residents worried that the brown stain of pollution would cause economic issues by stalling population growth and

[9] For more on post- World War II concerns about pollution and the rise of environmentalism see Samuel P. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985* (Cambridge: Cambridge University Press), 1989 and Christopher C. Sellers, *Crabgrass Crucible Suburban Nature and the Rise of Environmentalism in Twentieth-Century America* (Chapel Hill: University of North Carolina Press), 2012.
[10] "Air Pollution Control Suggested for Denver," *Fort Collins Coloradoan*, December 23, 1954, 15.

tourism as they believed people would avoid a city riddled with air pollution. However, in large part, the growth of the city was what caused the spike in air pollution. To make matters worse, residents, scientists and non-profits primarily focused on visible or smelly air pollution, such as smoke produced from industrial centers, but did not recognize automobiles as the number one source of air pollution in Denver, until much later because these emissions were often invisible and did not smell.

In 1950, the number of residents in the Denver metro area grew to 560,361 people.[11] During World War II, Colorado shifted from a ranching and mining-based community to a manufacturing center to assist the war efforts. Also, because the state is in the center of the country, located far from either coast, it was an unlikely place for an attack, and its central location meant that items could easily flow in and out of the city. Accordingly, the federal government moved federal agencies, such as the Atomic Energy Commission and the National Center for Atmospheric Research to the Denver area. After the war, Denver leaders continued to push big businesses to move to the city and many of the federal agencies remained. Furthermore, the large military and federal presence in Denver promoted the growth of the aerospace industry with companies such as IBM, Hewlett-Packard and Lockheed Martin moving some of their operations to Denver. Oil and gas companies opened offices in the Denver area because of the city's proximity to energy fields, where the companies extracted oil and gas. These big businesses and federal agencies brought jobs and money to the Denver metro area.[12] In 1940, the Denver metro area's labor force totaled 169,143 people and by 1950 it grew to 231,800 people.[13]

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[11] John LeGloahec, "Denver, Colorado Statistically According to the 1950 Census of Population," National Archives: Text Messages, June 21, 2022.
[12] Gayle Baker, *Denver, A BoomTown History* (Winnipeg: Hignell Book Printing, 2004), 59-62.
[13] "1950 Census of Population Preliminary Reports: Characteristics of the Population of the Denver, Colo., Standard Metropolitan Area: April 1, 1950," U.S. Department of Commerce, Bureau of the Census, May 17, 1951, pg. 2.

The job opportunities provided by the influx of federal agencies and big businesses caused the population to swell, which consequentially amplified air pollution.

Many of the families moving to Denver for these job opportunities took up residence in the suburbs. In 1950, the census counted 560,361 people living in Denver and the surrounding suburbs, Adams, Arapahoe, Boulder and Jefferson.[14] In part, families moved to the suburbs because automobiles allowed residents to drive to work, while simultaneously enjoying the benefits of the suburbs including larger homes, yards, and garages to store their cars. Post-World War II, the opportunity for good jobs with big businesses or the federal government led families from all over the country to move to Denver. Also, local businesses and politicians used the state's natural beauty, including the Rocky Mountains, to promote an aggressive growth in tourism and tout Denver as an ideal location to raise a family.[15] Both increased job opportunities and Denver's often idyllic climate contributed to the rapid growth the city experienced in the mid twentieth century.

Between 1940 and 1960, the population of the Denver Metropolitan Area more than doubled from 445,206 residents in 1940 to 929,383 residents in 1960 with around seventy five percent of residents living in the four metropolitan counties surrounding Denver.[16] To assist this growth, the 1956 Federal Aid Highway Act authorized to the construction of Interstate I-70 and Interstate I-25, connecting Denver to the surrounding suburbs via highway.[17] The new highways made accessing the city by car quicker, but also as created more air pollution. However,

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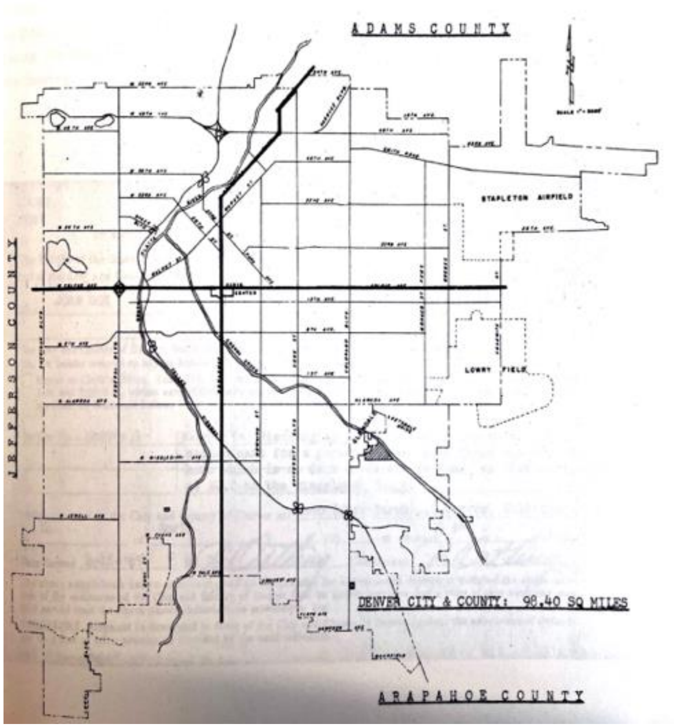
[14] LeGloahec, "Denver, Colorado Statistically According to the 1950 Census of Population," 2022.
[15] Andrew R. Goetz and E. Eric Boschmann, *Metropolitan Denver: Growth and Change in the Mile-High City* (Philadelphia: University of Pennsylvania Press, 2018), 74-75.
[16] Carl Abbott, "Suburb and City: Changing Patterns of Socioeconomic Status in Metropolitan Denver Since 1940," *Social Science History* 11, no. 1 (Fall 1977), 53-54.
[17] Goetz and Boschmann, *Metropolitan Denver*, 74.

lawmakers failed to consider making the city reachable by public transit. As more people moved to the suburbs, and used cars to commute to the city, Denver's air quality quickly deteriorated.



1968 Map of the Denver Metro Area. John E. O'Fallon, Fred H. Longenberger, Frank E. Thruston Jr., and Leonard A. Dobler. *Denver Air Pollution Control 'Meeting the Challenge' Extracted from Denver APC Publication For 1968*, Denver Public Library, Denver Metro Chamber of Commerce Collection WH1216, Board of Directors,- Air Pollution Task Force- Box 69, Folder 20.

In 1962 researchers with the Denver Air Pollution Control (APC) team studied the how the city's topography, elevation, and climate impacted air pollution. The Denver metro area is situated on the east side of the Rocky Mountains, and in the South Platte River Valley. The Rockies on the western side of Denver rise upwards of 14,000 feet. And on the eastern side of the metro area, as the distance from the South Platte River increase, the elevation starts to rise slightly, to about 5,600 feet. Meanwhile, Denver and the metro area lie in the South Platte River Valley at about 5,280 feet, a mile above sea level. The researchers found that because the Denver metro area is surrounded by higher ground, the land on either side of the city acts as a barrier, trapping air pollution over the Denver metro area, and creating an inversion. An inversion occurs when there is a relatively warm layer of air, trapping cold polluted air near the ground and preventing it from dispersing. Typically, air pollution is dispelled horizontally by wind, vertically by rising warm air, or washed away by rain. But Denver only receives an average of 8.23 inches of rain a year.[18] So, during spells, or when wind is low and cold air is near the ground, meteorologic factors fail to clear the pollution.[19]After the 1962 study, researchers had a clear understanding of how Denver's topography, elevation, and climate impacted air pollution.

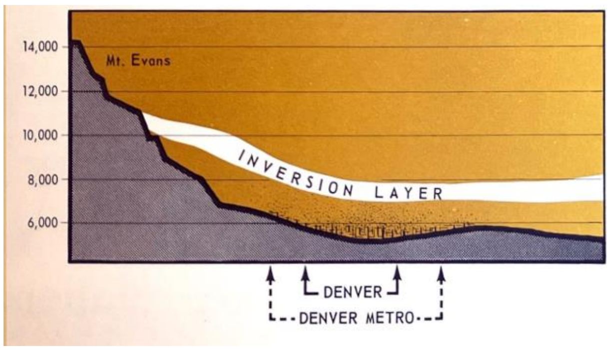


Illustration of the inversion layer over the Denver Metro Area which leads to pollution build up over the city. Located in a report on Denver Air Pollution Control in August 1967. Denver Public Library, Denver Metro Chamber of Commerce Collection, Board of Directors- Air Pollution Task Force- Box 69, Folder 20.

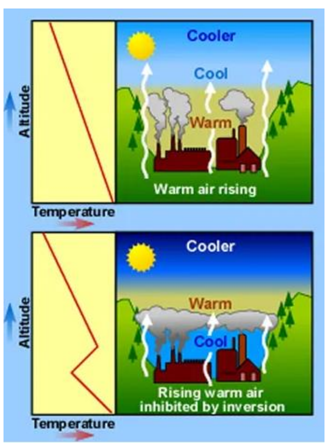


Illustration of warm air trapping cold, polluted air near the ground.
EPA

Then, in 1968 the Denver APC team looked at how the high elevation of Denver also exacerbated air pollution. To summarize, the researchers found that the city is about a mile above sea level, which means there is less oxygen in the air as compared to cities closer to sea level. Less oxygen in the air causes automobiles to emit more pollution. Internal combustion engines,

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[18] "County Time Series: Precipitation, Year-to-Date, All Months, 1895-2024, Denver County, Colorado" Climate a Glance County Time Series, National Centers for Environmental Information, National Oceanic and Atmospheric Administration, https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/time-series/CO-031/pcp/ytd/0/1895-2024?base_prd=true&begbaseyear=1901&endbaseyear=2000
[19] John E. O'Fallon, *A Report to the Mayor and City Council on Denver Air Pollution Control in August 1967*, Denver Public Library, Denver Metro Chamber of Commerce Collection, Board of Directors- Air Pollution Task Force- Box 69, Folder 20.

which power vehicles by burning gasoline, do not operate as effectively at higher altitude. Combustion engines require a balance of oxygen, fuel, and a spark. When the automobile is lacking one of these elements, it becomes less efficient because it tries to make up the difference by using more fuel, and, as a result, producing more pollution.[20] The 1968 study found that automobiles in Denver produced thirty seven percent more carbon monoxide than cars at sea level.[21] Ultimately, a lot of sunlight, low rain, wind, and oxygen levels, cold winters, and the location of the metro area in the South Platte River Valley make air pollution especially severe in the Denver metro area. As Denver's population increased, so did the number of cars on the road, and the city's geography, climate, and elevation magnified the health and aesthetic problems resulting from pollution emitted by automobiles.

Around the same time that Denver's population started to expand, the Colorado and U.S. Departments of Public Health first studied the state's air pollution. In 1955, President Dwight D. Eisenhower signed the Air Pollution Control Act into law. This act allocated fifteen million dollars to state governments to study air pollution, providing Colorado with funds to begin researching the sources and levels of their air pollution. In 1956, Colorado released the results from the study funded by this law. To the dismay of concerned citizens and environmentalists, this study did not result in any change because the researchers determined that Denver was only near adverse levels of air pollution. Since the city did not have adverse levels of air pollution, the Colorado and U.S. Departments of Public Health recommended that the best thing for the state to

[20] For more on the how automobiles produce air pollution see Richard Chase Dunn and Ann Johnson, "Chasing Molecules: Chemistry and Technology for Automotive Emissions Control," in *Toxic Airs: Body, Place, Planet in Historical Perspective*, ed. James Rodger Fleming and Ann Johnson (Pittsburgh: University of Pittsburgh Press, 2014), 109-126.

[21] John E. O'Fallon, Fred H. Longenberger, Frank E. Thruston Jr., and Leonard A. Dobler. *Denver Air Pollution Control 'Meeting the Challenge' Extracted from Denver APC Publication For 1968*, Denver Public Library, Denver Metro Chamber of Commerce Collection WH1216, Board of Directors,- Air Pollution Task Force- Box 69, Folder 25.

do was monitor air pollution to make sure it did not reach dangerous limits.[22] But by the early 1960s, air pollution worsened, and the Colorado State Department of Public Health sought another air pollution study to ensure the air was not a threat to public health.

Furthermore, as Denver's population grew in the mid twentieth century, air pollution became hard to ignore, leading business non-profits to start advocating for reducing emissions to ensure air pollution did not halt the growth of Denver. By the early 1960s, the Denver Metro Chamber of Commerce (DMCC) was one of the first non-profits to start seeking air pollution mitigation. Businesses from nearly every industry across the state, including oil and gas, mining, and automotive businesses made up the DMCC. Consequently, they approached air pollution from the viewpoint of business interests. In other words, they did not want air pollution control that would financially harm businesses. Instead, they sought air pollution mitigation that would keep the skies clear to protect the growing economy. The DMCC believed that if air pollution continued to worsen then people would no longer move to or visit Denver, resulting in mired economic growth.

The DMCC was first established in 1867 and had a long history of lobbying the city to prioritize growing the economy of Denver.[23] By the early 1960s, the group turned to air pollution as a threat to economic growth and asked legislators to start cleaning up the air using state and federal funds. To showcase the problem of air pollution, the DMCC started to review studies that analyzed the causes of air pollution to ensure that the recommendations and goals devised in the plans would not cost businesses money. They supported air pollution mitigation, as long as the

[22] Joseph Palomba Jr. and Richard F. Wromble, *An Appraisal of Air Pollution in Colorado, Colorado State Department of Public Health, U.S. Department of Health, Education and Welfare Public Health Service, November 1961 to June 1962*, pg. 3, Denver Public Library, Denver Metro Chamber of Commerce Collection, Board of Directors- Task Force-Air Pollution- Box 39, Folder 4.
[23] Denver Metro Chamber of Commerce, Who We Are, History & Milestones, Accessed March 2, 2024.

solutions did not lessen their bank accounts. At the same time, they wanted to better understand how the pollutants impacted human health and aesthetic views, specifically of the Rocky Mountains. The DMCC argued that these issues could carry over to economic decline.

As a follow up to the 1956 study, the Colorado State Department of Public Health published a second air pollution study in 1962 and started to look at strategies to mitigate air pollution. The 1962 study opened with recommendations for state and local governments, industries, and universities to take to alleviate air pollution. Most importantly, the study asked these entities to create a monitoring system and to develop a comprehensive air pollution control program.[24] The study noted that tourism was Colorado's third largest industry by 1962, but air pollution threatened the viability of the growth of tourism. This confirmed the DMCC's fear that air pollution would cause Denver's economic growth to stall. Additionally, the study pointed to the growth of the manufacturing industry as the main cause of air pollution and provided an extensive analysis of the impact of Denver's climate, weather, and elevation on air pollution.[25] But the researchers neglected to analyze automobile pollution. The Colorado Department of Public Health started to understand the impact Denver's environment had on air pollution and began mitigating stationary sources of pollution, but automobile emissions continued to worsen throughout the decade.

The 1955 Air Pollution Control Act started to acknowledge that air pollution could cause health, economic and aesthetic issues, but the act did not actually mandate change. Instead, it served as a forerunner to subsequent legislation that would require state and local governments and industries to start cleaning up the air. Both the 1956 and 1962 air pollution studies in Denver concluded that while the city was at risk for adverse side effects of air pollution, it was not yet

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[24] Palomba and Wromble, *An Appraisal of Air Pollution in Colorado,* November 1961 to June 1962, 2.
[25] Palomba and Wromble, *An Appraisal of Air Pollution in Colorado,* November 1961 to June 1962, 10.

experiencing air pollution disasters like Donora, PA did in 1948 when 20 people died and around 5,900 people (around 43 percent of Donora's population) suffered respiratory ailments due to the smog.[26] Unlike Donora, Denver never had a smog event that directly resulted in people dying.[27] Thus, in the 1960s legislators and residents did not as actively push for air pollution mitigation in Denver, as compared to other cities.

The Clean Air Acts, 1963 to 1969

The mid 1960s ushered in new federal air pollution laws that moved beyond research and established state and local programs to investigate techniques to monitor and control air pollution, resulting in the shift from studying air pollution to mitigating it. Federal pollution laws assisted local efforts to combat pollution by providing state and local entities with more funding. In 1963, the U.S. Congress passed the Clean Air Act, which provided Colorado with more funds to research air pollution. This act allocated ninety-five million dollars to study and clean up air pollution at the local, state, and federal levels, and awarded Colorado a federal grant to establish the Air Pollution Control (APC) division in April 1965. The Denver APC team quickly got to work enforcing air pollution policies such as restrictions on incinerators and recommending legislation to mitigate air pollution. Seven departments formed the Denver APC team. Most importantly, the Inspection and Enforcement department investigated complaints and inspected industrial and commercial sites for violations, and the Engineering team developed air pollution

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[26] Jacobs, Burgess, and Abbott, "The Donora Smog Revisited," S85-S88.
[27] For more on the 1948 Donora smog event see Chris J. Magoc, "Reflections on the Public Interpretation of Regional Environmental History In Western Pennsylvania," *The Public Historian* 36, no. 3 (2014): 50–69. And Andy McPhee, *Donora Death Fog: Clean Air and the Tragedy of a Pennsylvania Mill Town*, Pittsburgh: University of Pittsburgh Press, 2023. For more on smog events in St. Louis see Andrew Hurley, *Common Fields: An Environmental History of St. Louis*, St. Louis: Missouri Historical Society Press, 1997. For more on smog events in Los Angeles see William Deverell and Greg Hise, *Land of Sunshine: An Environmental History of Metropolitan Los Angeles*, Pittsburgh: University of Pittsburgh Press, 2006.

control devices, and monitored air pollution that posed economic or biological harm to Denver residents. All seven departments reported to the Director of Denver APC, John E. O'Fallon. [28] Although Denver APC only had jurisdiction over stationary sources of air pollution, such as incinerators and industrial plants because state and federal agencies maintained control of mobile sources of pollution, such as automobiles, complicating strategies for improving air quality.

Furthermore, the APC published a summary of the work they completed between 1965 and 1967, and they maintained the claim of earlier studies that the health impacts of air pollution in Denver were low. This rhetoric followed along the same lines as the 1956 and 1962 studies complete by the Colorado Department of Public Health claiming that air pollution was primarily an aesthetic and economic issue. The lack of proof that air pollution in Denver posed a health threat to citizens, led Denver residents and lawmakers to focus on aesthetic and economic issues of air pollution, instead of the health issues. In the 1967 report, John E. O'Fallon, the director of the Denver APC division noted that "Denver's air pollution problem is primarily one of visibility, which has a considerable effect upon Denverites, esthetically and economically."[29] Nonetheless, the 1967 report established five major goals to prevent and eliminate air pollution in Denver. Similarly, to the 1956 and 1962 studies, the 1967 plan centered on surveying air pollution sources. However, it went a step further and planned to reduce stationary sources of pollution, determine air quality criteria and emission standards, develop long range plans for mass transportation, and increase the control of air pollution in the Denver metro area. While the APC did not make any substantial efforts at improving mass transportation in Denver because of a lack of funding, they did effectively eliminate over forty percent of pollution emitted from

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[28] John E. O'Fallon, *A Report to the Mayor and City Council on Denver Air Pollution Control in August 1967*, Denver Public Library, Denver Metro Chamber of Commerce Collection, Board of Directors- Air Pollution Task Force- Box 69, Folder 20.
[29] O'Fallon, *A Report to the Mayor and City Council on Denver Air Pollution Control in August 1967.*

stationary sources such as open burning, incinerators, and industrial processes.[30] But simultaneously the number of cars registered in Colorado skyrocketed to 1,099,568 in 1970. Neither the APC, nor other local agencies could attempt to control mobile sources of pollution until the federal government passed legislation allowing them jurisdiction over mobile emitters.

In 1967 President Lyndon B. Johnson signed the Air Quality Act, which put state and local governments in charge of their own pollution problems. However, the act also allowed the federal government to intervene if states failed to adequately improve their air quality. But this act only applied to stationary sources of pollution and did not allow the federal government to enact nationwide emissions standards.[31] Furthermore, it failed to mandate the use of technology to mitigate pollution. In an article published in *Law and Contemporary Problems* on the deficiencies of the act, O'Fallon proposed that the federal government should mandate the use of technology to reduce pollution levels.[32] The act ultimately did not do much for Denver because as O'Fallon argued the city needed the federal government to require the use of technology to prevent air pollution, but this legislation did not come until the 1970s.

Just a year later, the APC recognized air pollution as a public threat for the first time. To further mitigate air pollution, the APC published a booklet in 1968 to inform the public about the threat air pollution posed to the economy, environment, and public health. This booklet is one of the first times that a state or local agency in Colorado acknowledged that Denver' s air pollution was above adverse levels. The recognition that Denver's air was unsafe likely came because of the continuous air monitoring that begun earlier in the decade. The researchers claimed that "we

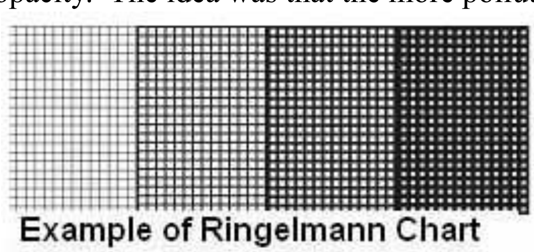
[30] Ibid.

[31] Lyndon B. Johnson, "Remarks Upon Signing the Air Quality Act of 1967," Online by Gerhard Peters and John T. Woolley, The American Presidency Project.

[32] John E. O'Fallon, "Deficiencies in the Air Quality Act of 1967," *Law and Contemporary Problems* 22, no. 2 (1968): 275-296.

will never purge the air of all contaminants, but we can, with an all-out effort, reduce drastically the pollution now present, and maintain it at levels conducive to health and continued economic progress."[33] The booklet also noted that by 1968, automobiles were the number one source of pollution in Denver, contributing an estimated 90 percent of the city's air pollution. In part, cars became the number one source of pollution because the local and state governments successfully mitigated most stationary sources of pollution such as incinerators through inspection and enforcement by the APC.[34]

Finally, by late 1968, as part of the mandate of the Air Quality Act the National Air Pollution Control Agency, which regulated air pollution, required Denver to work with state and local agencies to create a method for determining allowable particulate emissions. Particulate emissions are the different chemical particles and droplets that are suspended in the air. The plan that the Denver APC division devised required that machines with an internal combustion engine, such as automobiles, could not emit pollution with more than twenty percent opacity for over ten consecutive seconds.[35] The idea to base pollution regulations on opacity came from the Ringelmann chart which suggested that the opacity of smoke correlated with the density of the pollution. The chart had grey and black grides with twenty, forty, sixty and eighty percent opacity. The idea was that the more polluted air was, the higher it would rank on the chart. The



Example of Ringelmann Chart. History of Grand Rapids.

[33] John E. O'Fallon, Fred H. Longenberger, Frank E. Thurston, and Leonard A. Dobler, *Denver Air Pollution Control "Meeting the Challenge," Extracted from Denver APC Publication for 1968*. Denver Public Library, Denver Metro Chamber of Commerce Collection, Board of Directors- Air Pollution Task Force- Box 69, Folder 20.
[34] O'Fallon, Longenberg, Thurston, Dobler, *Denver Air Pollution Control "Meeting the Challenge,"* 1968.
[35] Letter from Thomas C. Young Executive Director of Engine Manufactures Association to Fred H. Longaberger Chief Air Pollution Control Engineer for Denver Air Pollution Control on February 19, 1969, Denver Public Library, Denver Metro Chamber of Commerce Collection, Board of Directors- Air Pollution Task Force, Box 69, Folder 20.

ranking was determined by matching the smoke opacity to one of the grids. So, by proposing an opacity of twenty percent, Denver sought to limit pollution emissions to the strictest standard as established by the Ringelmann chart. The APC's plan was to measure incomplete combustion from cars based on its opacity. The darker the emissions were from a car, the more pollution an engine spewed into the air.[36] But oil and gas companies, such as those aligned with the DMCC argued that the APC's plan was unenforceable and would financially affect Denver businesses. They feared that basing emission controls on the Ringelmann chart would pose economic problems for the oil and automobile industries.

To fight the APC's plan to monitor automobile emissions using the Ringelmann chart, oil and gas companies sought a new study group led by the DMCC and the Colorado Petroleum Council, the local branch of the American Petroleum Council, a national trade association representing all facets of the oil and gas industry. Companies such as Chevron, Conoco, and Allied Chemical Company asked the APC to form a study group that would prioritize business interests over environmental protection, and provide what they claimed would be a more fair analysis of the financial cost of smoke abatement.[37] The proposed study group only included business interests that would be directly affected by stricter air pollution controls because these were the companies producing goods, such as gasoline, that ended up polluting the air. For example, the Engine Manufacturers Association wrote to the APC claiming that because of Denver's altitude, an opacity of twenty percent on the Ringelmann chart was not possible and continued that the federal standard for automobile engines was 40 percent opacity. Therefore, a

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[36] Bureau of Mines, United States Department of the Interior, *Ringelmann Smoke Chart* (Revision of IC 7718), May 1967.

[37] Memorandum from Olie Webb to Rex Jennings regarding Air Pollution Ordinance Task Force on June 18, 1969. Denver Public Library, Denver Metro Chamber of Commerce Collection, Board of Directors- Air Pollution Task Force, Box 69, Folder 20.

city such as Denver, where air pollution was more difficult to control because of the altitude, should not have a state opacity standard that was stricter than the federal standard.[38] Letters such as this flooded the mailbox of the APC, as oil and gas companies begged them to revise the Air Pollution Control plan to a forty percent opacity standard instead of twenty percent.

The study group led by the DMCC and the Colorado Petroleum Council focused their research on the financial impact that environmental regulations would have on businesses. On September 15, 1969, Olie Webb, the group manager for DMCC presented the findings of the study group to the Denver City Council Public Improvements Committee. Webb concluded that the group was "concerned that as a reduction in commercial pollution sources occurs, new regulations affecting existing and future business may result in an increase in paperwork, reporting and personnel to support such efforts, rather than a significant reduction of actual pollutants."[39] Basically oil and gas companies feared that stricter regulations would cost them money. Because the Denver APC did not regard this as a legitimate concern, they rejected the pleas of the oil and gas study group and continued mandating an opacity of twenty percent.

In the next few years as the federal government passed stricter air pollution laws, oil and gas companies continued to fight against automobile emission regulation. In the 1970s, lawmakers moved away from using the impressionistic Ringelmann chart to monitor air pollution. Instead, scientists and engineers focused on creating technology to calculate the exact amount of pollutants, such as carbon monoxide, emitted from cars. Additionally, in Denver environmental non-profits started to take the place of business non-profits, and the

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[38] Letter from Thomas C. Young to Fred H. Longenberger on the Air Pollution Control in Denver, February 19, 1969. Denver Public Library, Denver Metro Chamber of Commerce Collection, Board of Directors- Air Pollution Task Force, Box 69, Folder 20.

[39] Introductory remarks presented to Denver City Council Public Improvements Committee by O.L. Webb, Group Manager for the Metro Development Denver Chamber of Commerce on September 15, 1969, Denver Public Library, Denver Metro Chamber of Commerce Collection, Board of Directors- Air Pollution Task Force, Box 69, Folder 20.

environmental groups placed the health impacts of air pollution at the forefront of their campaign. The 1960s, witnessed a push for clean air to ensure Denver remained aesthetically pleasing, but it would take environmental activists to persuade the federal government to pass stringent laws prioritizing clean air over economic interests and requiring technology that could mitigate air pollution emitted from automobiles.[40] Eventually, because of the actions of the environmental movement, President Richard Nixon signed into law the Clean Air Act of 1970, finally moving the country and Denver to a path towards cleaner air.

Air Pollution as a Public Health Crises

By 1970 the environmental movement was gaining steam as physicians such as Dr. Roy H. Hart, who worked at the Medical University of South Carolina, predicted that by the end of the decade there would be a lung cancer epidemic in cities such as Denver because of emissions from automobiles.[41] Citizens used the looming public health crises to propel the environmental movement and push federal lawmakers to pass policies that would prioritize health over economics. In 1970, the environmental movement successfully elected the "Ecology Congress" that Senator Gaylord proposed at Earth Day. With an environmentally driven legislative branch, Congress passed a slew of rigorous environmental policies that provided real action to cleaning up the planet. However, this legislation took time to make an impact. It took until the 1990s to adequately mitigate air pollution in Denver because the state needed time develop tactics to mandate new technology that reduced automobile emissions.

[40] For more on legislation prioritizing a clean environment over economic interests see James Morton Turner and Andrew C. Isenberg. *The Republican Reversal: Conservatives and the Environment from Nixon to Trump*. Cambridge: Harvard University Press, 2018.
[41] "Pollution-Caused Epidemic Feared," Portland Press Herald, May 27, 1970.

In Denver, the environmental non-profit, Colorado Citizens for Clean Air (CCCA) joined the environmental movement, forming in May 1969 with the main objective of eliminating Colorado's air pollution by providing direct citizen input and participation. Led by chairwoman Dr. Ruth Weiner, a professor of Chemistry at Temple Buell University and vice chairman Gerald (Jerry) Jensen, a Denver attorney, the group established five priorities to combat air pollution: 1. Develop and enforce air pollution standards in Colorado, 2. Improve air pollution legislation, 3. Create an effective education processes, 4. Increase memberships of the CCCA, and 5. Establish a statewide organization.[42] The CCCA took a rather modest approach to environmentalism, in hopes that this strategy would mediate communication between both sides. Most importantly, after the federal government revamped the Air Quality Act in 1970, the CCCA assisted Colorado lawmakers in devising a plan to reduce automobile pollution.

After the passage of the 1970 Clean Air Act Amendments, the DMCC strayed away from the air pollution mitigation conversation likely because the federal government now mandated how local and state governments managed Colorado's air quality. The DMCC mainly lobbied the local government, and since the local government no longer set the standards for the Denver metro area's air quality, the DMCC likely choose to spend their resources elsewhere. Also, it is unlikely that the DMCC and CCCA communicated as the CCCA did not form until the DMCC moved away from the air pollution fight. While the DMCC was separating itself from the air pollution debate, the CCCA was in the midst of becoming one of Denver's staunchest allies in the fight for clean air.

Groups such as the CCCA merged with the national modern environmental movement that pushed for cleaner air, water, and land starting in the early twentieth century and expanding

[42] Ruth Weiner, Gerald Jensen, and Don Neil, "Colorado Citizens for Clean Air," 1971, Denver Public Library, Colorado Environmental Coalition, CONS137, Box 10, Folder 22.

in the 1960s, largely because of the health impacts of pollution. As historian Adam Rome explains in *The Genius of Earth Day*, after World War II, biologist Barry Commoner "became concerned with the environmental consequences of technological development… [and] argued repeatedly that scientists had a duty to provide citizens with the scientific knowledge needed to make informed decisions about environmental issues."[43] Then in 1962, Rachel Carson, a marine biological with the U.S. Bureau of Fisheries, published her bestselling book, *Silent Spring*, detailing the devastation that pesticides such as DDT cause on the human body. Like Commoner, Carson explained that biologists had a duty to educate the public about the impact humans have on the environment and the health threats posed by pollution. Many scientists joined Commoner and Carson in relaying to citizens the health threat that pollution can pose to the human body. As citizens increasingly understood the looming public health crises, many joined the modern environmental movement, made up of groups such as the CCCA, to push for federal legislative action and better technology to mitigate pollution.

Arguably, 1970 was the most important year for the modern environmental movement. In addition to the first Earth Day celebration in April, President Richard Nixon signed the bipartisan Clean Air Act Amendments in December 1970, heralding a new era in air pollution mitigation.[44] The 1970 amendments effectively federalized air pollution standards, meaning that the federal government now had the power to intervene if state and local governments did not meet national air quality standards because of stationary or mobile emitters.[45] More importantly, the act prioritized the environment over the economy and mandated the installation of catalytic

[43] Adam Rome, *The Genius of Earth Day: How a 1970 Teach-In Unexpectedly Made the First Green Generation*, (New York: Hill and Wang, 2013), 21.
[44] For more on the bipartisanship of air pollution legislation in the 1970s see James Morton Turner and Andrew C. Isenberg. *The Republican Reversal: Conservatives and the Environment from Nixon to Trump*. Cambridge: Harvard University Press, 2018.
[45] Scott Hamilton Dewey, *Don't Breathe the Air: Air Pollution and U.S. Environmental Politics, 1945-1970* (College Station: Texas A&M University Press, 2000), 5.

converters in cars made after 1975. Catalytic converters transform harmful emission such as carbon monoxide into less harmful carbon dioxide before the emissions exit the cars exhaust system.[46] The Clean Air Act of 1970 made strides towards implementing technology that prevented pollution, but also allowed people to continue driving automobiles.

As Dewey argued in *Don't Breathe the Air,* leading up to 1970 industries maintained that air pollution was a local problem that required more studies and local solutions, however, businesses also said that solutions would lead to job loss, higher prices for goods, and overall economic hardships.[47] Until 1970, the federal government avoided passing any laws with the potential to solve the air pollution problem, fearing that industries were correct. Instead, with the 1955, 1963, and 1967 air pollution control laws the federal government gave state and local governments the power to mitigate air pollution without federal intervention, allowing them the ability to prioritize business interests and economic growth over environmental progress.[48] But these laws failed. It became clear that lawmakers needed to pass a strong federal law that prioritized human health over the cost to industries.[49] Finally, largely because of concerned scientists and the growing environmental movement, the federal government took bold steps against industries and established deadlines for companies to come into compliance with newly established standards or receive a fine.[50] But mandating the new regulations would take time.

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[46] Dunn and Johnson, "Chasing Molecules," in *Toxic Airs*, 121-123.
[47] Dewey, *Don't Breathe the Air*, 244-245.
[48] For more on the economics of air pollution mitigation see Charles Halvorson, *Valuing Clean Air: The EPA and the Economics of Environmental Protection*, Oxford: Oxford University Press, 2021.
[49] For more on the environmental movement see Karl Boyd Brooks, *Before Earth Day: The Origins of American Environmental Law, 1945-1970*, Lawrence: University of Kansas Press, 2009., Finis Dunaway, *Seeing Green: The Use and Abuse of American Environmental Images*, Chicago: Chicago University Press. 2015., Andrew Kirk, *Collecting Nature: The American Environmental Movement & The Conservation Library,* Lawrence: University of Kansas Press, 2001., and Adam Rome, *The Genius of Earth Day: How a 1970 Teach-In Unexpectedly Made the First Green Generation*, New York: Hill and Wang, 2013.
[50] Paul G. Rogers, "EPA History: The Clean Air Act of 1970," US Environmental Protection Agency, January/February 1990.

Just weeks before the passage of the Clean Air Act Amendments, the newly designated Environmental Protection Agency (EPA) began operations on December 2, 1970. The mission of the EPA was to protect human health and the environment by ensuring that Americans had clean air, among other resources. The formation of the EPA merged pollution control programs, such as the National Air Pollution Control, with the Environmental Health Divisions and the U.S. Public Health Service. President Nixon also placed the EPA in charge of overseeing the federal mandates of the 1970 Clean Air Act Amendments. One of the primary tasks of the EPA, as ordered by the Clean Air Act Amendments of 1970 was to set National Ambient Air Quality Standards (NAAQS). The law required the EPA to establish standards on a national level for six criteria air pollutants: ozone, atmospheric particulate matter, lead, sulfur oxides, nitrogen oxides, and most important in the case of Colorado, carbon monoxide. The EPA measured carbon monoxide in parts per million (ppm). PPM is one part of carbon monoxide per million parts of air.[51] The EPA set the NAAQS for carbon monoxide at nine ppm for eight hours. Meaning, that carbon monoxide levels must not average more than nine ppm over the course of eight hours on more than one day a year.

The second task for the EPA was to approve each state's SIPs. The SIPs established a strategy to meet or maintain air pollution levels at or below the NAAQS by 1975. In 1971, carbon monoxide levels in Denver averaged twenty to thirty ppm and peaked at thirty-two ppm. Colorado had to devise a plan to reduce their carbon monoxide levels to less than nine ppm over an eight-hour period.[52] Once they devised a plan, it would be sent to the EPA for approval, and they would ensure that Colorado's SIP detailed a adequate strategies to meet the NAAQS by

[51] "Evolution of the Clean Air Act," United States Environmental Protection Agency, November 21, 2023.
[52] Testimony of Jerry Jensen, Chairman of Colorado Citizens for Clean Air Before the Denver Planning Board, December 15, 1971, Denver Public Library, Colorado Environmental Coalition, CONS137, Box 13, Folder 2.

1975.[53] The 1970 Clean Air Act Amendments and the establishment of the EPA slowly started developing benchmarks to mitigate air pollution, but how exactly Colorado would implement these requirements remained unclear.

After the passage of the Clean Air Act Amendments of 1970, the CCCA ramped up activities to ensure that Colorado established a SIP that would appease concerned residents. The CCCA found speakers for hearings, facilitated workshops, wrote newsletters, and published studies looking at how Denver could reduce pollution and to spread the word about why air pollution was a health problem. Their campaign centered on limiting the use of automobiles in Downtown Denver because of the health threat posed by carbon monoxide. By 1971, Denver metro area residents condemned air pollution first and foremost because of its threat to public health.[54] To solve the public health crises the CCCA lobbied the State of Colorado to reduce the number of automobiles on the road in Downtown Denver.

Markedly, the CCCA gathered speakers for emission control hearings where the Colorado APC team listened to concerns about air pollution. At the behest of the CCCA, Franklin D. Cardwell, the president of Dopp Systems Inc. an engineering consultant company, spoke before the Colorado APC hearing on Emission Control for Mobile Sources in January 1971. Cardwell claimed that "no motorist would knowingly pick up a killer—yet most of us do, every driving day of our lives. That's the grim conclusion of many researchers who point to carbon monoxide as the hitherto little-suspected culprit in what some call 'The Great Highway Murder Mystery.'"[55] Cardwell's eccentric speech explained in great, sometimes overexaggerated detail,

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[53] "Evolution of the Clean Air Act," United States Environmental Protection Agency, November 21, 2023.
[54] Jensen, Chairman of Colorado Citizens for Clean Air Testimony Before the Denver Planning Board, December 15, 1971.
[55] Statement of Franklin D. Cardwell Before the Colorado Air Pollution Control Commission Hearing on Emission controls for Mobiles Sources, January 12, 1971, Denver Public Library, Colorado Environmental Coalition, CONS137, Box 12, Folder 16.

the health consequences of inhaling carbon monoxide. Simply put, inhaling carbon monoxide reduces oxygen levels in the blood which can lead to dizziness, headaches, drowsiness, and loss of perception. Furthermore, Cardwell claimed that drivers were more likely to experiences these symptoms while behind the wheel. And then, these symptoms could lead drivers to crash their cars, injuring or killing themselves or others.[56] Cardwell was correct that carbon monoxide was dangerous, but his conclusions were more inflated than those held by the CCCA. Nonetheless, his speech showcased the importance of understanding air pollution in terms of public health and the breadth of beliefs held by environmentalists. Some environmentalists, such as Cardwell wanted a complete elimination of cars, while the CCCA sought a reduction in cars using mass transit and carpooling to substitute solo-driving, and others, such as O'Fallon, believed people could continue driving with the proper technology.

Then, in early 1972, the State of Colorado finalized the draft of their SIP and distributed copies to the CCCA, Colorado Department of Health, and the Denver Public Library in hopes that citizens would use the plan to participate in the upcoming hearings to finalize the draft. To meet the NAAQS, Denver had to reduce their carbon monoxide emissions by fifty two percent by 1975. The plan provided four strategies to achieve this reduction: 1. Decrease the number of cars on the road by thirty three percent and supplement automobiles with mass transit, 2. Require exhaust inspection and control devices on pre-1968 cars, 3. Promote carpooling and bus ridership, and 4. Request an extension from the EPA because there was no suitable strategy to reduce Denver's carbon monoxide levels by 1975. Denver legislators decided on option four.[57] Clearly, the State of Colorado knew what they needed to do to reduce air pollution, but they still

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[56] Ibid.

[57] Colorado Department of Health, Air Pollution Control Division, "Summary of Air Quality Implementation Plan for State of Colorado," January 1972, Denver Public Library, Colorado Environmental Coalition, CONS137, Box 13, Folder 1.

tried to opt out of immediate action to buy themselves more time while they fought over how to implement and afford the first three strategies.

At the hearing on the Colorado SIP before the APC, Jerry Jensen, who by 1972 was the chairperson of the CCCA, identified two major fallacies in the plan. First, Jensen noted that the SIP did not meet federal criteria or EPA standards. Second, and more critical, the plan did not meet the NAAQS for carbon monoxide and did not consider Denver' high altitude. Instead, the APC's plan was to ask for an extension, which Jensen claimed was an invitation to disaster. In lieu of asking for an extension, the CCCA recommended that Colorado should develop a better public transportation system and require automobiles to meet the federal emissions standard by 1975. The group saw mass transit as the best long-term solution because ideally citizens who travelled form the suburbs to the city each day for work would substitute solo driving with taking mass transportation. However, this would require the government to subsidize mass transit and they would need to create a system that was convenient for tens of thousands of suburbanites. The CCCA sought to make mass transit attractive by improving routes, giving buses the fight of way, and increasing express buses and parking at bus stops on the outskirts of town. The CCCA also claimed that these actions would take less than a year to implement.[58] But in the end the lawmakers ignored the advice of the CCCA. While in theory the Clean Air Act Amendments of 1970 would clean up the atmosphere, this law was only designed to work if the states took adequate measures.

Despite the CCCA's pleas to quickly implement a plan to reduce automobile emissions, the State of Colorado submitted their SIP, and asked for a two-year extension on reducing carbon

[58] Jerry Jensen, "Testimony of Colorado Citizens for Clean Air Before the Air Pollution Control Commission on the Colorado Implementation Plan," January 12, 1972, Denver Public Library, Colorado Environmental Coalition, CONS137, Box 13, Folder 1.

monoxide emissions from automobiles to meet the new federal standards. And in June 1972, the EPA granted them this two-year extension.[59] This extension gave Denver until 1977 to meet the NAAQS for carbon monoxide. Then, new amendments to the Clean Air Act in 1977 gave the state another extension until 1982.[60] The state continued working towards reducing carbon monoxide emissions, but because they kept receiving extensions, they did not suffer any consequences when they did not meet the NAAQS. From 1970 until 1982, restrictions on carbon monoxide emissions levels tightened, and researchers worked towards developing technology to make cars cleaner to drive. Concurrently, the number of cars registered in Colorado continued to increase and reached 1,739,718 in 1980, but all the cars built after 1975 did likely have catalytic converters, reducing their emissions. In the end it would be better technology, not better public transit or less cars on the road, that ended up improving Denver's air quality.

Throughout the 1980s, activists and lawmakers in Denver continued to preach for more carpooling, preferential treatment of buses, better bikeways, and overall improving public transit. For two decades, the CCCA put forth the same recommendations to reduce air pollution but failed to put consequential actions behind their words. In 1986, Denver held the title for the city with the worst carbon monoxide pollution in the U.S with an average of 25.8 ppm of carbon monoxide.[61] However, by the end of the decade the city slowly started to reduce its carbon monoxide levels because federally mandating technology such as catalytic converters.

Furthermore, amendments to the Clean Air Act in 1977 adjusted auto emission standards and started requiring emissions testing in Denver and thirty-seven other metro areas that did not meet the NAAQS for carbon monoxide. Beginning in 1981, the Clean Air Act Amendments of

[59] "State's air pollution control plan approved," *Fort Collins Coloradoan*, June 1, 1972.
[60] "Carter requests delay in auto pollution plan," *Fort Collins Coloradoan*, April 18, 1977.
[61] "Denver's air cleanup targets new deadline," *The Daily Sentinel*, November 18, 1987.

1977 required that most Denver metro area residents test their car at an inspection and maintenance center before registering or renewing the vehicles registration. Emissions testing measured the pollutants emitted from a vehicle to ensure they did not exceed the ppm for carbon monoxide and other emissions as set by the EPA.[62] The ppm varied depending on model year, and type of vehicle. For example, a 1971 light duty vehicle could not exceed 3 ppm, but a light duty car with a model year of 1981 or newer could not exceed 1.2 ppm.[63] If a car failed the test, the owner had to make modifications such as adding a catalytic converter, to reduce emissions and test the vehicle again before they could register it. Coupling inspection and maintenance with the requirement of catalytic converters, started to make a significant dent in Colorado air pollution, and in 1985 the state's carbon monoxide levels averaged eleven to twelve ppm.[64]

To further reduce carbon monoxide emissions, Colorado legislators mandated the use of oxygenated in 1988.[65] Denver and the Front Range of Colorado became the first area in the nation to require the use of oxygenated fuel in automobiles. The state required gas stations to sell oxygenated gas from January 1 through March 1. Oxygenated fuel is 90 percent gasoline and ten percent additive and oxygen, which improves combustion in automobile engines, reducing exhaust emissions by making it easier for cars to start in Denver's low-oxygen environment.[66] Lawmakers only required oxygenated gas in the winter because it evaporates quicker than low volatile gas. When gas evaporates it increases ozone pollution. So, in cold months, Denver supplied oxygenated fuels, and in summer they switched to a less volatile blends.[67] It would take

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[62] Federico Peña, "Clean Air Remarks," November 15, 1988, Denver Public Library, Colorado Environmental Coalition, CONS137, Box 13, Folder 3.
[63] "Code of Colorado Regulations: Air Quality Control Commission," 5 CCR 1001-13, EPA, pg. 41.
[64] "National Air Quality and Emissions Trends Report, 1985," US Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Park North Carolina, pg. 5.10, 5-40.
[65] Federico Peña, "Clean Air Remarks," November 15, 1988, Denver Public Library, Colorado Environmental Coalition, CONS137, Box 13, Folder 3.
[66] "Oxygenated Fuel Ruling," *Washington Post*, June 30, 1987.
[67] Peña, "Clean Air Remarks," November 15, 1988, DPL, CEC, CONS137, Box 13, Folder 3.

a couple more years to see the complete progress brought by these automobile technologies. But despite Colorado's automobile registrations reaching a record high at 2,114,555 in 1990, Denver finally did not violate the carbon monoxide standards in 1995 because of the requirement of catalytic converters, emissions testing, and oxygenated gas.[68]

Twenty-five years after the passage of the Clean Air Act Amendments of 1970, Denver residents finally experienced a year where carbon monoxide never exceeded the NAAQS. Activists and lawmakers could not agree on a solution to the automobile crisis, but once technology proved to mitigate the issue, Denver citizens started to see an improvement in their air quality. The modern environmental movement slowly influenced federal lawmakers to pass legislation that would reduce pollution. Environmentalists may have failed to reduce the number of cars on the road, but new technology successfully reduced carbon monoxide levels in Denver. Finally, in 2002, the EPA declared that the city was no longer above the NAAQS for carbon monoxide, changing the city's designation to an attainment area in the twenty first century.

Conclusion

While it took Denver decades, they did reach attainments levels for carbon monoxide because the modern environmental movement pushed federal legislators to pass stringent laws mandating the use of air pollution mitigation technology. The Clean Air Act Amendments of 1970 determined that if air quality in a geographic area did not meet the NAAQS for pollutants, such as carbon monoxide, then the EPA would declare that area as being in non-attainment, which is how they classified Denver. To achieve attainment that area had to include a strategy for attainting and maintain emissions in their SIP.[69] Environmentalists including the CCCA, pushed

[68] "Motor Vehicle Registrations, By States, 1900-1995," Federal Highway Administration, pg. 2.
[69] "Process to Determine Whether Areas Meet the NAAQS (Designation Process)," *EPA*, November 30, 2023.

for strategies such as better public transit to reduce the number of cars on the road, and others, such as Cardwell sought a complete elimination of driving. A third group, consisting of environmentalists such as O'Fallon believed technology would solve the pollution problem because they understood that people would not give up the freedom and comforts of driving.

Public transit, including a bus system and a light rail system, exists in Denver, but they do not significantly reduce the number of cars on the road because of the inflexibility in the routes, the cost, and because it can increase the time it takes to commute. Furthermore, biking was never a plausible solution because of Denver's erratic weather, with freezing, snowy days in winter, and 100+ degree days in summer months. While environmental groups such as the CCCA pushed for change and many Coloradoans saw the need for air pollution mitigation, nearly no one wanted to give up driving. To reduce the number of cars of the road, lawmakers would need to make biking or riding public transit more convenient than driving. To do this, they could increase the number of and route of buses, improve the routes of the light rail, significantly raise the cost of parking in Denver, subsidize riding public transit, and to ensure they have enough workers to run the public transit system pay its workers well.

Even without a reduction of the number of cars on the road, Denver maintained carbon monoxide levels below nine ppm from 1995 to 2001, leading the EPA to officially redesignate Denver as being in attainment for carbon monoxide in August 2002.[70] First, the requirement of catalytic converters in cars built after 1975 reduced emissions by turning carbon monoxide into carbon dioxide. Then, the 1977 amendments requiring emissions testing, forced residents to test how much carbon monoxide their vehicles emitted and set a standard they had to achieve to register their cars. Last, the use of oxygenated gas in 1988 made engines operate more efficiently

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[70] Matthew Benson, "More people, more cars expected to cause more pollution problems," *Fort Collins Coloradoan*, December 4, 2002.

in winter months. Over thirty years after the passage of the Clean Air Act Amendments of 1970, technology allowed Denver to achieve the national attainment levels for carbon monoxide.

Ultimately, Denver would not have achieved attainment for carbon monoxide without the actions of the modern environmental movement pushing for federal legislation. First, early studies mandated by the air pollution acts in the 1950s and 1960s provided lawmakers with funds to study air pollution, which identified how Denver’s climate, elevation, and topography worsened the air pollution problem. Then, in the 1970s, further studies revealed that carbon monoxide emitted from automobiles did pose a public health threat. The public health threat of carbon monoxide and the growing modern environmental movement influenced activists to push for a reduction in the number of cars on the road. However, neither lawmakers, nor environmental activists devised a successful plan to reduce the use of automobiles. Instead, technology, spurred on by federal programs and pushed for by activists, finally improved Denver’s air quality.