



AIR QUALITY, CLIMATE CHANGE, AND COVID-19

Part One of a Two Part Series Examining the Public Health, Climate, and Economic Impacts of COVID-19 and Wildfires and How Transportation Electrification Can Be Part of the Solution

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PREFACE

By Philip B. Jones, Executive Director of the Alliance for Transportation Electrification (ATE) and Nick Nigro, Founder of Atlas Public Policy

We are pleased to support, on behalf of ATE and Atlas Public Policy, a joint initiative to pull together the research on the far-reaching challenges of the COVID-19 pandemic on health, climate, the economy, social justice, and our energy and transportation systems. We have been working together on ways to promote clean transportation systems for over three years, and we have been identifying key areas and potential gaps in policy studies. The spread of the novel coronavirus into a global public health pandemic was earth-shaking and renewed our sense of urgency to engage in this work in a way that focuses on the virtues of humility, the art of listening, and learning from others.

We were together in Washington D.C. last year in March 2020 when some state governments announced the first lockdowns in response to the growing pandemic. Phil rushed home on an airplane to Seattle, and neither of us have travelled by air or to an EV or energy conference since that meeting.

While that experience was comparatively mild, millions of Americans have had their lives, families, jobs, and communities severely disrupted by the pandemic. Over 500,000 Americans have lost their lives, and many families and communities have had their lives changed forever. We have all had to confront decisions around where we live, how we associate and congregate, and how we work and travel to our place of work, if we do not work from home.

This paper series seeks to highlight the connection between the challenges of the last year and those that will continue to unfold in the years to come. While the pandemic raged across the country, Western states experienced unprecedented wildfires forcing thousands to flee their homes and seek shelter. These individuals had to face the compounding challenges of losing their home and staying safe during the global pandemic. Wildfires are becoming more unpredictable and dangerous in these states and have been exacerbated by the greenhouse gases emitted by our economy, including those from the transportation sector. We must work harder to reduce emissions in order to lessen the impact of modern society on climate change.

Together, we felt it was important to try to think through some of the complex interactions and factors that led to or exacerbate challenges we confront today, and try to sort through the various pieces of the puzzle including climate, air quality and human health, increasingly intense and frequent wildfires, disproportional impacts of this crisis on BIPOC communities, and ultimately transportation electrification and the adoption of zero emission vehicles and the necessary charging infrastructure to support them. We recognize that these are all significant issues on their own, and the first paper in this series does not attempt to establish strict causality or linkages between these major challenges. Instead, the paper encompasses a broad range of research and analysis important both to our society and economy, including the public health impacts of the current crisis, as well as the severe economic consequences, especially the loss of jobs and people seeking permanent employment, due to the restrictions and lockdowns. We think there is great value in trying to pull together many of these documents and references in one place.

In this paper, we seek to collect and reference the foundational documents and studies that highlight the challenges we are facing and set the stage for the second paper, where we outline the value of transportation electrification as part of the solution. Moreover, we believe there is a need to do further analysis of the impacts of the pandemic on transportation modes, potential responses to wildfires in the Western states, and other key issues regarding public health, our energy system, and the climate.

State and local governments, electric utilities, auto and truck manufacturers, electric vehicle charging service providers, and non-profit organizations have been leading the path forward in modernizing our energy and transportation systems. We are clearly moving toward cleaner electric generation and zero-emission vehicles – the real question is how to accelerate the pace of change in a thoughtful and equitable way. Today, we have a federal government that promises to enhance those efforts and accelerate these trends with some major initiatives, although we all know that many challenges and bends in the road lie ahead of us.

Over the past year, we have seen strong leadership among many of the Members in ATE and through the EV ecosystem in accelerating moves in transportation electrification. We have also witnessed the resiliency of the American spirit and our tradition of innovation and collaboration as we are now accelerating the path toward a more sustainable and low-carbon energy future.

We hope that that this first paper will open some new horizons and avenues for discussion in our community on the vital issues of social justice, climate, energy, public health, wildfires and intense weather, and jobs and the economy. The pandemic and its consequences have demonstrated how we need to think beyond our present boundaries and take the time to learn the experiences of others. We also hope that this paper helps establish some of the foundation for that dialogue, and that you will stay tuned for our next paper that will focus on the role of transportation electrification in helping to meet these challenges.

Sincerely,

Philip B. Jones

Philip B. Jones, Executive Director
Alliance for Transportation Electrification (ATE)



Nick Nigro, Founder
Atlas Public Policy

COVID-19 and the severe 2020 wildfire season have had an extreme impact on economic, health, and social justice challenges in the United States. Americans continue to contract the virus at elevated rates, contributing to persistent high unemployment and job loss as businesses temporarily and permanently close [1, 2]. These challenges are not distributed equitably and research shows that communities of color face worse health and economic outcomes due to the pandemic compared to white communities [3, 4]. These disparate economic and health outcomes are exacerbated by preexisting inequalities. Studies have shown that disproportionate concentrations of air pollution in underserved communities are contributing to higher mortality rates from COVID-19 [5, 4]. Meanwhile, the extreme 2020 wildfire season, the largest on record this century in terms of acreage burned, has raised the need to rapidly reduce greenhouse gas emissions to mitigate the effects of climate change, which contributes to the increasing intensity of wildfires [6].

Accelerating the electrification of the transportation sector has an important role to play in mitigating climate change, reducing local air pollutants, and stimulating economic recovery from COVID-19.

This paper describes the economic, health, and social justice challenges from both COVID-19 and the 2020 wildfire season and highlights the role of transportation electrification¹ in being one of many critical responses to the challenges. This paper is the first paper in a two-part series. The second paper in the series will provide a closer look at the specific ways transportation electrification can address these challenges and includes an exploration of near-term policy and funding opportunities to decarbonize the transportation system.

INTRODUCTION

The COVID-19 pandemic and the severe 2020 wildfire season have exacerbated and, in several cases, added to the economic, health, and social justice challenges in the United States. The closure of businesses and reduction in services due to social distancing practices enacted to slow the spread of the virus have resulted in high unemployment. Joblessness rates climbed to a post-Great Depression peak of 14 percent in April 2020 with the second quarter bringing the steepest quarterly drop in national GDP on record [1, 7]. While the unemployment rate fell following the April peak to 6.7 percent, the percentage of unemployed Americans was twice as high as pre-pandemic levels and the number of jobs created fell in December highlighting continued economic uncertainty [8]. The unemployment numbers also do not fully capture the amount of underemployment resulting from the pandemic. The number of jobless people who are not looking for work – due in part to safety concerns and the belief that there are no jobs available due to the struggling economy – and the number of people accepting part-time work who would like to be working full-time also peaked in April. Both measures remain significantly higher than pre-pandemic levels [7].

¹ Throughout this paper, the use of the term transportation electrification or EV refers to battery electric vehicles unless otherwise specified.

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A closer look at these numbers indicates that marginalized populations including Black and Latinx² communities face higher unemployment and more severe economic hardships due to the pandemic compared to white workers [3, 9, 10]. In addition to higher job loss, communities of color also face unequal health outcomes from COVID-19. Reports and research from the American Lung Association (ALA) and the Harvard T.H. Chan School of Public Health have made clear the connection between disproportionate exposure to air pollution in underserved communities and higher COVID-19 death rates among low-income people of color in the United States [5, 11].

The pandemic has unfolded in tandem with increasing environmental impacts from climate change. Wildfires are becoming more intense as a result of high concentrations of greenhouse gases in the atmosphere with the average annual burn acreage increasing throughout the 21st century [12]. The \$3.6 billion price tag associated with responding to the 2020 wildfires and other extreme weather events estimated by the National Interagency Fire Center has placed additional strain on states seeking to provide services for their citizens as they struggle to contain the spread of the coronavirus [6].

The criteria pollutants emitted from wildfires contribute to the already disproportionate air quality burdens faced by communities of color in the United States. Farm workers, in particular, have been forced to forgo wages for the sake of protecting themselves from unhealthy levels of particulate matter (PM) pollution from fires [13, 14].

Both the pandemic and the severe wildfire season have brought increased attention to connections among air quality, climate change, public health, and economic and environmental justice. Reducing emissions from all sectors will be essential to address these challenges and transportation electrification serves as both a necessary intervention and unique opportunity with wide-ranging benefits. In addition to providing air quality benefits to mitigate climate change and promote public health, market transformation through the electrification of transportation can be an important source of jobs and investment, making it a valuable way to stimulate economic recovery from the impacts of COVID-19.

Fluctuating travel patterns due to social distancing and other pandemic-induced restrictions on mobility have allowed scientists to study the potential for reduced transportation emissions to result in less air pollution. Data collected by the National Aeronautics and Space Administration (NASA) found there was a significant drop in levels of atmospheric nitrogen dioxide, a criteria pollutant emitted primarily from the burning of gasoline and diesel fuels, during the early months of the pandemic when restrictions on movement were the most severe [15]. Research from the Rhodium Group estimates that transportation-related greenhouse gas emissions were down 15 percent in the United States in 2020 as a direct result of the pandemic. This reduction in emissions held up even as travel restrictions were eased and personal vehicle travel reached pre-pandemic levels as early as June 2020 [16].

However, Rhodium and other analysts caution these emissions reductions will be fleeting in the absence of “meaningful structural changes in the carbon intensity of the U.S. economy” [17]. The data gathered during these months of reduced travel have created valuable scientific support for the potential benefits from decreased air pollution through transportation electrification [17]. The connections between air quality, transportation, wildfires, and the pandemic have led elected officials including California Governor Gavin Newsom and industry experts like Dr. Shelley Francis of EV Noire to call for rapid transportation

² The Economic Policy Institute report referenced here uses the term “Latinx” to refer to Americans who self-identify as “Hispanic” in government data surveys.

electrification [18, 19]. Investment in transportation electrification has the potential to provide meaningful stimulus to accelerate economic recovery. Federal stimulus in particular has had a significant impact on job creation in clean energy and transportation. Spurred by historical stimulus efforts including the American Recovery and Reinvestment Act (ARRA), clean energy jobs, including clean transportation, have been growing four times faster than national employment between 2017 and 2019 according to research from E2 [20]. While clean vehicle employment has been growing overall, the pandemic has led to a 12 percent decline in clean energy jobs between March and December compared to pre-pandemic levels [21].

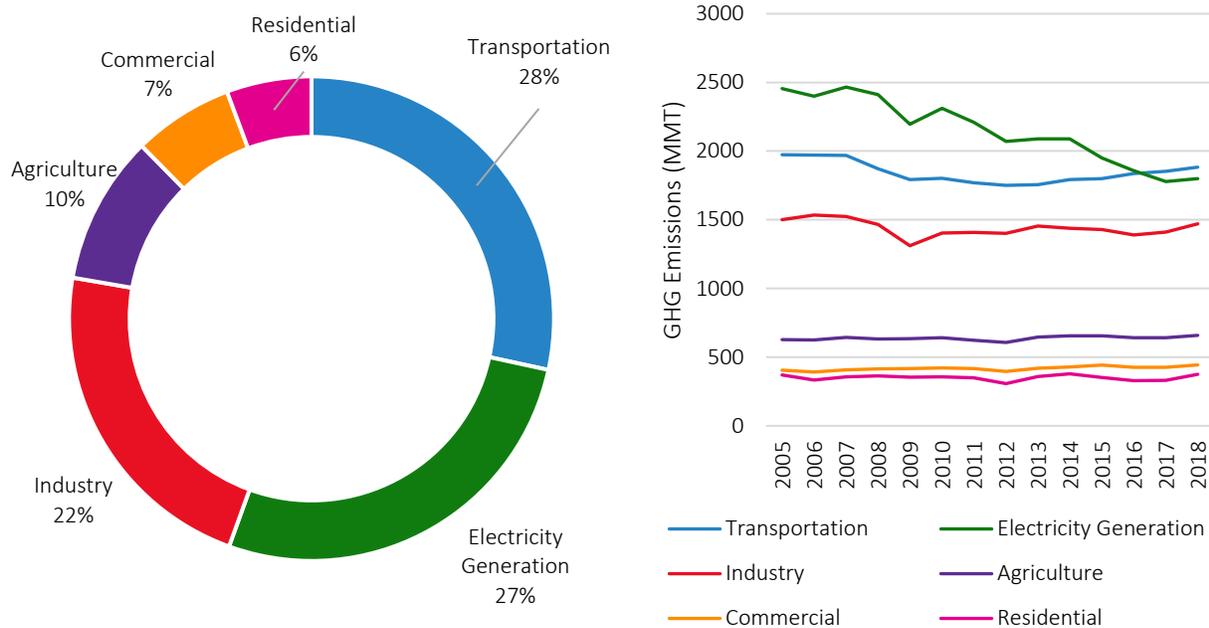
Pandemic-related declines in clean vehicle employment are likely to be short lived with analysts anticipating high growth at the state, regional, and national levels. In Texas, BW Research estimates that the electric vehicle (EV) workforce will double by 2024 [22]. Even Pennsylvania, which has no major auto manufacturing facilities, has an EV workforce greater than existing fossil fuel operations [23]. In the Southeast, at least 5,800 people are expected to be employed directly in passenger EV and battery manufacturing facilities, many of which were commissioned in the last two years [24]. Increasing federal support from transportation electrification could create more than 700,000 jobs annually for ten years [25]. Furthermore, programs that focus on the needs of underserved communities can begin to address the systemic environmental injustice experienced by people of color at a critical time in the course of the COVID-19 pandemic [19].

This paper describes the economic, health, and social justice challenges from both COVID-19 and the 2020 wildfire season. The role of transportation in these pressing challenges is explored and while a range of actions across multiple sectors is needed, this paper highlights transportation electrification as an essential part of the solution and a unique opportunity to realize widespread benefits. This paper is the first paper in a two-part series. The second paper in the series will provide a closer look at the specific ways transportation electrification can help to address these challenges and includes an exploration of near-term policy and funding opportunities to decarbonize the transportation system.

COVID-19, AIR QUALITY, AND PUBLIC HEALTH

The U.S. Environmental Protection Agency (EPA) said in 2016 that the transportation sector surpassed the electric power sector as the leading source of greenhouse gas emissions in the United States. Reductions in the carbon intensity of the U.S. electrical grid through the introduction of renewables and transition from coal to natural gas between 1990 and 2019 have driven a 13 percent decline in emissions compared to 2005 levels [26]. This decarbonization resulted in transportation emerging as the leading greenhouse gas emitter in recent years and has led to increased attention on reducing emissions from on-road vehicles. While all economic sectors have considerable work to do to mitigate the worst effects of climate change, policymakers have focused attention on transportation electrification in hopes of leveraging the efforts to clean the grid. Figure 1 shows the breakdown of greenhouse gas emission by sector in the United States based on 2018 data.

FIGURE 1: 2018 U.S. GHG EMISSIONS BY SECTOR AND EMISSIONS OVER TIME

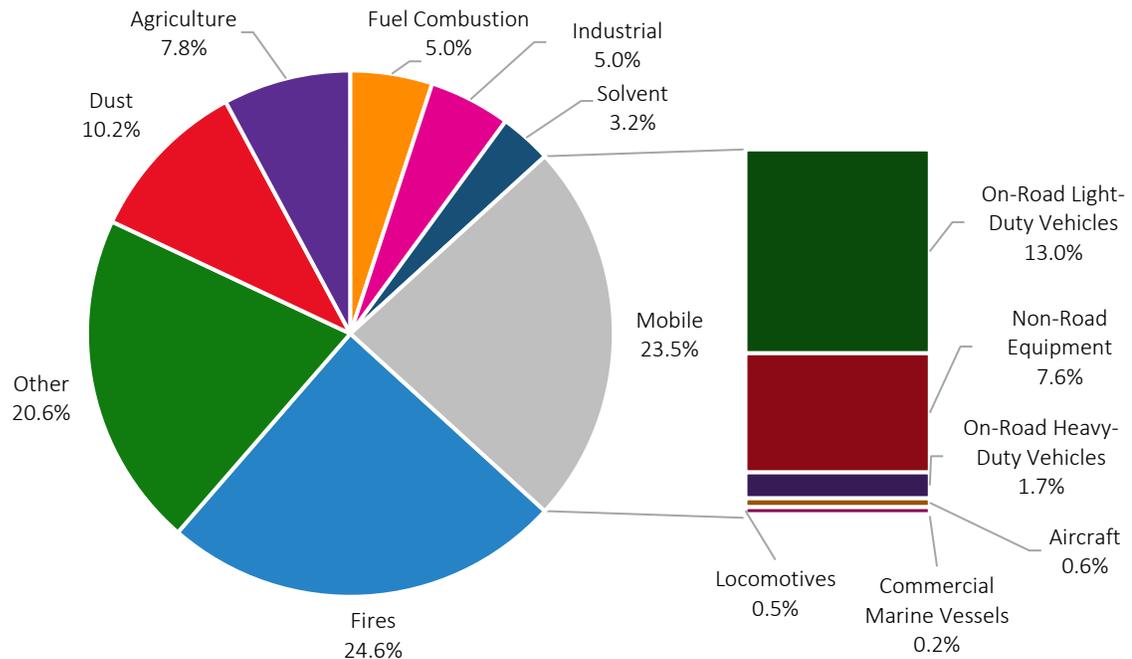


This shows the greenhouse gas contributions of each major sector in the United States for 2018 and over time from 2005 through 2018. Before 2016, electricity generation was the leading source of greenhouse gas emissions in the United States. In 2018, transportation contributed 28 percent of the greenhouse gas emissions in the country, just ahead of the 27 percent contribution from electricity generation.

Source: Environmental Protection Agency [27]

Although the climate debate has primarily focused on the imperative to reduce greenhouse gas emissions, reducing criteria air pollutants, such as nitrogen oxides (NO_x) and soot created from the combustion of fossil fuels, particularly from vehicles is also important in order to improve air quality and public health. According to EPA, mobile sources are roughly tied with fires as the primary sources of criteria air pollution in the country [5, 26]. Largely because of emissions from older vehicles, particularly diesel, the transportation sector is responsible for the largest share of ozone- and particle-forming NO_x and is a major source of particle pollution. These pollutants have well-documented negative effects including increased risk of asthma attacks, lost work days, and premature death [5]. Figure 2 provides a breakdown of the distribution of criteria pollutant emissions by sector and within the transportation subsector.

FIGURE 2: 2017 CRITERIA AIR POLLUTANT EMISSIONS BY SECTOR AND BY MOBILE SOURCES



This chart shows criteria pollutant emissions by sector (left) and within the mobile sources sector (right) in the United States for 2017. Fires lead mobile sources in terms of total criteria pollutant emissions. Light-duty vehicles lead the mobile emissions subsector with 55 percent of the emissions in this category.

Source: Environmental Protection Agency [27]

In addition to the negative impacts of criteria air pollutants, greenhouse gas emissions also influence public health outcomes. At a high level, climate change poses both direct and indirect threats to public health, as warmer temperatures increase the formation of certain air pollutants such as ozone and increase the risk and intensity of drought, dust, and wildfires, all of which contribute to increased particle pollution [29]. Furthermore, the ALA report highlights that the negative health effects of transportation and power sector emissions are not distributed equitably. Communities of color are more likely to be near major sources of pollution like highways, ports, and power plants, resulting in a greater concentration of air pollution in these communities [5]. In California in particular, Black and Latinx communities face between 15 and 18 percent greater exposure to dangerous criteria pollutants like fine particulate matter (PM_{2.5}) from the transportation sector compared to the state average. White people have an average exposure rate 17 percent below the California average [30].

The Center for Disease Control (CDC) reports that, in the absence of regulations and complementary programs designed to curb criteria pollutant emissions from transportation, electric power, and other sources, the number of premature deaths could increase by between 1,000 and 4,300 annually by 2050. The annual health costs associated with the levels of criteria air pollution from all sources measured between 2000 and 2002 are estimated at \$6.5 billion [31].

While ozone concentrations have declined by 22 percent between 1990 and 2016, the 2018 National Climate Assessment warns that ozone concentration could become more severe under climate change and counteract the positive impacts of market transformation through the electrification of

transportation. The 2018 assessment estimates that efforts to mitigate climate change could reduce annual premature deaths related to ozone by 500 through 2090 [32]. In addition to fewer premature deaths and avoided health costs, the ALA report projects significantly fewer asthma attacks and lost work days under aggressive renewable energy and transportation electrification pathways between 2020 and 2050 [29], reflecting the importance of economy-wide action to reduce greenhouse gas emissions and other air pollutants.

Data collected by the Harvard T.H. Chan School of Public Health during the initial months of the COVID-19 pandemic further highlights the link between air pollution and negative health outcomes. The study found that COVID-19 death rates are higher among people who live in areas with higher concentrations of fine particulate matter, also known as PM_{2.5}, a pollutant whose primary sources include vehicles and wildfires [11, 33]. In fact, the study finds that even a small increase in long term exposure to PM_{2.5} results in significantly higher risk of more severe COVID-19 outcomes. Specifically, one microgram increase in particulate pollution can increase COVID-19 mortality rates by 11 percent [4]. The study found that, an individual living in an area with higher average PM_{2.5} pollution is eight percent more likely to die of COVID-19 than someone living in an area with one unit less of PM_{2.5} concentration. The study notes that these findings provide additional, not new, support for the link between air pollution and public health, as the negative effect of PM_{2.5} on many other cardiovascular and respiratory illnesses is well documented [11].

The pandemic has brought the disparity in health outcomes driven by class and race to the forefront of the national conversation around public health and environmental justice. Disparities in health outcomes across racial groups are not limited to those located in urban areas with high concentrations of air pollutants. Indigenous communities have been some of the hardest hit by the pandemic. The Center for Disease Control finds that “American Indian or Alaska Native” people are four times more likely to be hospitalized compared to white people. Factors influencing this increased risk factor are socioeconomic status, access to health care, and exposure to the virus related to occupation [34]. In addition to these, Native Americans suffer from disproportionately high rates of preexisting conditions including asthma and heart disease [35].

Exposure to high concentrations of urban air pollution only increases vulnerability. The National President and CEO of ALA has been outspoken recently in the urgent nature of this public health crisis and the need for public health organizations to work collaboratively with state governments, utilities, non-governmental organizations, and others to address this crisis. He explains, “[f]ar too often, clean air is out of reach for communities living near major pollution sources, including highways, ports and power plants. Communities of color are disproportionately harmed by poor air quality in the United States. The time to act on electric transportation is now [5].” Dr. Shelley Francis, former director of public health with the Georgia Department of Public Health and co-founder of an equity-focused clean transportation group called EV Noire, explains that since the transportation sector is one of the largest sources of air pollution, electrifying transportation is essential in order to address the inequitable impacts of air pollution on public health [19].

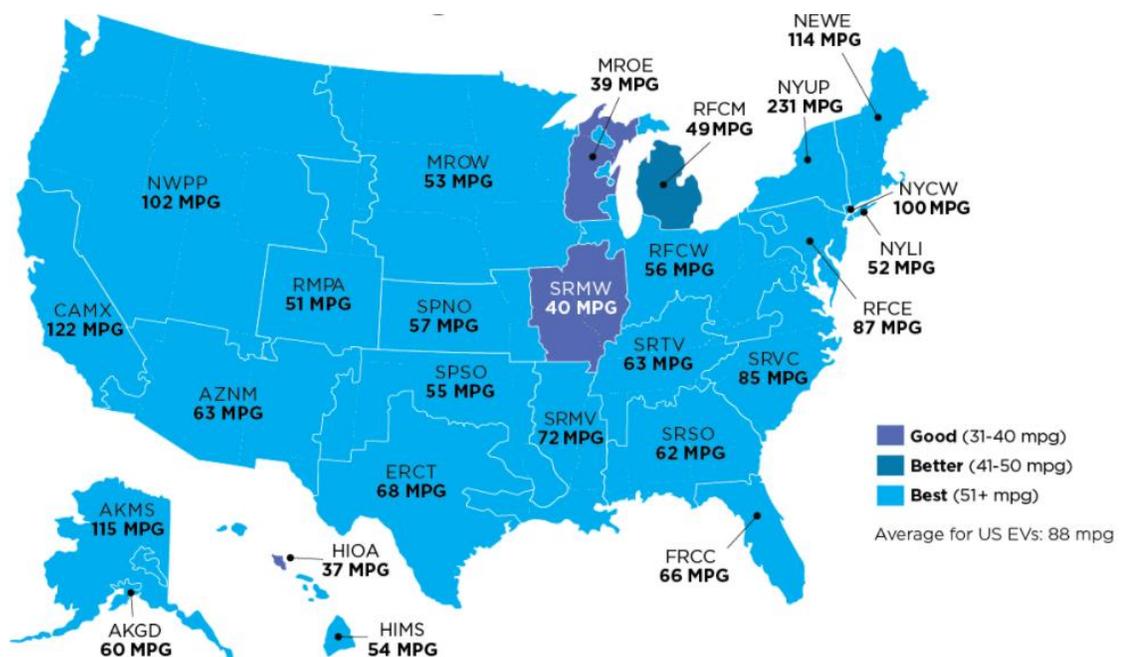
The unprecedented reduction in road traffic that occurred during the first few months of social distancing in the United States provided a rare opportunity to collect data on the short-term air quality impact of sharply reduced tailpipe emissions. During this time, data collected by NASA found there was a notable drop in levels of atmospheric nitrogen dioxide, a criteria pollutant emitted primarily from the burning of gasoline and diesel fuel. Specifically, satellite data collected by NASA shows that the levels of atmospheric nitrogen dioxide in March 2020, when road traffic was around 40 percent lower compared to pre-pandemic levels, were the lowest of any other March going back to 2005 [36, 15]. Through March and April, concentrations of nitrogen dioxide and other air pollutants dropped by up to 30 percent in urban areas in major metropolitan regions including New York and Los Angeles [36, 37]. These trends have also

been seen globally where satellite imagery from March showed that concentrations of air pollutants from transportation sources fell by up to 70 percent compared to 2019 levels in nations including China and the United Kingdom [38]. Eliminating tailpipe emissions has the potential to make these temporary gains permanent and lead to lasting public health improvements [15].

Transportation is only one source of emissions and its share of both greenhouse gas and criteria pollutant emissions varies significantly in regions and states across the country depending on the electric generation mix and other forms of pollution. In some states with cleaner generation portfolios like Washington, the transportation sector contribution to greenhouse gas emissions can reach more than 60 percent. On the other hand, West Virginia has a more carbon intensive power system and transportation contributes only 14 percent of greenhouse gas emissions. There is a similar variation in the transportation sector share of NO_x emissions across states [27]. With the electrical grid getting steadily cleaner as coal-fired plants are phased out and more renewables are brought online, EVs combined with power grid decarbonization can deliver even more emission reductions. The potential ways EVs can support a decarbonized electrical grid are explored in the second paper in this series.

Across the country, light-duty vehicles contribute the most to both criteria air pollutants and annual vehicle miles traveled, accounting for 55 percent and 89 percent of each category, respectively [39]. However, while light-duty passenger vehicles contribute the most to criteria pollutant emissions on an aggregate basis, the per-vehicle contribution of medium- and heavy-duty vehicles is greater. Electrifying these vehicles could provide significant emissions benefits with EVs responsible for lower greenhouse gas emissions on a well-to-wheels basis than the average conventional vehicles in every electrical grid region of the country. Figure 3 shows the fuel economy equivalent rating of EVs compared to conventional vehicles around the United States.

FIGURE 3: MILES PER GALLON EQUIVALENT RATINGS OF ELECTRIC VEHICLES COMPARED TO CONVENTIONAL VEHICLES THROUGHOUT THE UNITED STATES



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Throughout the United States, driving on electricity is cleaner than driving a gasoline-powered vehicle. The miles per gallon equivalent for gasoline-powered vehicle is listed by region. On average, EVs are equivalent to a gasoline-powered vehicle achieving a fuel economy of 88 miles per gallon in terms of overall greenhouse gas emissions.

Source: Union of Concerned Scientists [40]

The emissions saving potential of transportation electrification is significant and extends across all use cases for vehicles. While medium- and heavy-duty vehicles like transit buses account only five percent of the vehicles on the road, the per-vehicle emissions saving potential is significantly higher [41]. These vehicles also contribute an outsized portion of dangerous criteria air pollutants and disproportionately impact low-income communities and communities of color, which are often located closer to sources of medium- and heavy-duty transportation pollution [42]. Leading states for transportation electrification policy like New Jersey are making environmental justice a priority for EV investment and deployment. In comments to Governor Murphy's February 2021 announcement establishing the Office of Climate Action and the Green Economy and allocating \$100 million to transportation electrification projects, Newark environmental justice community leader Kim Gaddy praised the program's focus on electrifying buses and trucks operating in underserved communities [43]. Gaddy noted the disproportionate impact these vehicles have on the public health of children of color [44].

The immediate and inequitable threat they pose to public health makes medium- and heavy-duty vehicles a top priority for transportation electrification nationwide. This is especially true since the pandemic has accelerated the shift to e-commerce, and consequently the demand for goods transportation, by five years according to IBM's U.S. Retail Index [45]. The acceleration of these anticipated transitions and the clear impact of transportation on air pollution shown by fluctuating travel patterns throughout the pandemic point to an increasing urgency to reduce the emissions of the transportation sector.

COVID-19 IMPACTS ON TRANSPORTATION

Fluctuating road traffic is just one of many impacts the pandemic has had on the transportation system in the United States. While social distancing orders enacted in March 2020 initially resulted in a sharp decrease in on-road traffic of 40 percent in leading metro areas including New York City and Los Angeles, traffic levels had already returned to 90 percent of pre-pandemic levels by June [16, 36]. Reports from traffic analyst INRIX indicate that personal travel fell by 46 percent at the height of stay-at-home orders while freight was down only 13 percent [46]. Data from the American Public Transportation Association (APTA) and budget and ongoing service cuts to public transportation agencies throughout the country have indicated more lasting impacts of the pandemic for public transit.

According to APTA, public transit ridership declined 76 percent in the second quarter of 2020 compared to pre-pandemic levels as personal vehicle road traffic rebounded [47]. The federal government attempted to address these challenges in March 2020 under the Coronavirus Air, Recovery, and Economic Security (CARES) Act [48]. Through CARES, transit agencies were given \$25 billion to staunch the steepest revenue losses experienced at the onset of social distancing and stay-at-home orders in March. Through September, transit ridership was down 50 percent compared to 2019 [49]. Even if ridership recovers in 2021, the financial impact of these declines is likely to have lasting effects as service providers across the country are making substantial budget, service, and job cuts. While research has shown there is no direct correlation between transit ridership and COVID-19 transmission, the fears among riders around of

transmission of the virus on the transit vehicle are pushing more people into individual vehicles where they feel safer [50]. While transit agencies have been taking extraordinary steps to sanitize, disinfect, and clean transit vehicles since the onset of the pandemic, more studies are required to assess the motivations driving consumer behavior and where the “new equilibrium” between transit and individual vehicle use, as well as transportation network companies (TNC) use and other modalities, will settle in the near term.

These challenges led transit agencies in key metro areas to propose substantial service modifications throughout the second half of 2020. New York City’s Metropolitan Transit Agency (MTA) is facing a \$16.4 billion deficit through 2024 and proposed to cut subway service by 40 percent and cut service on up to a quarter of bus lines in November [51]. In D.C., the Washington Metropolitan Area Transit Authority (WMATA) is facing a \$500 million deficit and announced plans to make severe service cuts in November as well. The original plans included eliminating weekend train service, decreasing train frequency to every 30 minutes, shuttering 19 metro stations, ending train service at 9pm instead of 11pm, and reducing bus service to 45 percent of pre-pandemic levels [52]. Similarly, Chicago Transit Authority and Denver Regional Transit Authority are facing a \$372 million and \$215 million budget deficit, respectively [51].

Transit agencies around the country gained some reprieve from expanding budget gaps and potential service cuts with the passage of the \$900 billion pandemic relief package in late December [53]. The package included \$14 billion in aid for struggling transit agencies, a sufficient amount of relief to avert major service cuts on the nation’s largest systems. New York’s MTA is set to receive at least \$4 billion of this relief funding and CEO Pat Foye indicates this will be enough to get the agency through 2021 without significant service cuts or layoffs. Other transit agencies in line for sizeable portions of this relief to avoid cuts are WMATA, Bay Area Rapid Transit in San Francisco, and King County’s Metro in Seattle [54]. However, this funding will likely not be enough to fully close budget gaps, which APTA estimates to be at least \$32 billion nationwide [55].

The recovery of public transit is essential to avert long-term increases in personal vehicle use and an accelerated shift to higher levels of transportation network company (TNC) ridership, carrying both equity and environmental concerns [16, 56]. Since TNC services are generally more expensive than public transportation services, these service cuts are particularly harmful to low-income people who do not own vehicles and depend on public transportation to get to work [57]. Data from APTA indicates that more than 70 percent of the population dependent on public transportation make less than \$50,000 a year and communities of color make up 60 percent of the total ridership on American public transit systems annually [58].

Increasing TNC ridership also poses substantial emissions risks for cities with high levels of these services. Research from the Union of Concerned Scientists in February 2020 found that ride-hail trips on TNC platforms like Uber and Lyft produce 69 percent more climate pollution than the trips they displace, because of miles associated with driving to the passenger and driving around between trips. Pre-pandemic research indicates that TNCs often capture riders who would have otherwise taken public transit, biked, or walked [59]. All indications point to an increasing share of vehicle miles traveled coming from ride-hail vehicles with Bloomberg New Energy Finance predicting that the TNC share of road travel will increase from five percent in 2018 to 19 percent by 2040 [60]. The immediate impacts of the pandemic on ride-hail ridership are unclear. Survey responses from a study conducted by the University of Chicago showed that participants reporting using ride-hail services dropped from 42 to 16 percent during the early months of the pandemic. However, at least 70 percent indicated they would likely use the services again before the end of 2020 [61].

Leading TNCs, Uber and Lyft, have made serious commitments to address the impact their services have on transportation emissions. In June 2020, Lyft led the charge by committing to electrify all vehicles, including those privately owned by drivers, on their platform by 2030 [62]. The company will generate funds to help their drivers transition to EVs through a surcharge on all rides and is working with organizations in the EV space on policy options to help achieve their targets. Uber followed suit with a similar commitment made in September to electrify their platform by 2040 [63].

The electrification of TNC vehicles will have an impact on tangential services as well. In addition to passenger trips, the pandemic has brought on a surge in food delivery services supported by TNC drivers. Through November 2020, food delivery platforms including Postmates, Grubhub, and DoorDash saw business more than double as a result of ongoing restaurant closures and stay-at-home restrictions [64]. Uber and Lyft are also aggressively courting this rapidly growing market segment. Uber's food delivery services increased 128 percent in the fourth quarter of 2020 compared to 2019 and delivery revenue nearly matched ride-sharing [65]. The surge in food delivery was just one element of an overall boom in delivery services seen throughout the country. Estimates released in December 2020 show a 32 percent increase in online retail sales in 2020 reaching volumes that had not been expected until 2022. The surge led to a ballooning of delivery truck fleets and increased miles traveled (VMT) throughout the year, and many experts expect this to continue in the future [66, 45].

Electrifying transportation is especially important considering the potential for more people to opt for passenger vehicle travel and reduce reliance on public transportation as the pandemic continues in 2021. Transit agencies, airlines, and other transportation providers will likely continue to face budgetary challenges as they look to the Biden Administration and new government in Washington for economic stimulus beyond the CARES Act and the Omnibus relief package from December 2020.

COVID-19 IMPACT ON ECONOMY

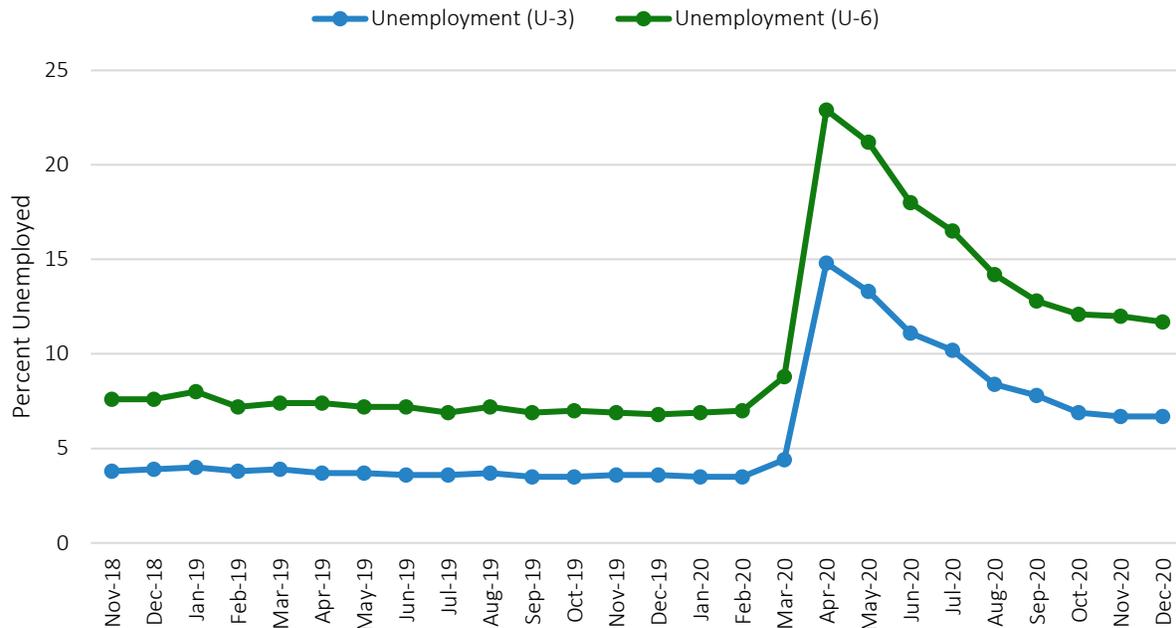
The U.S. economy overall took substantial hits throughout 2020. Unemployment in the United States soared from under four percent in February to over 14 percent in April following the onset of the most restrictive pandemic regulations in March 2020 [3]. This drop in unemployment coincided with the steepest quarterly drop in national gross domestic product (GDP) on record with a decline of nine percent in the second quarter [1]. GDP was down an estimated 3.5 percent for the entire year [17]. Since it peaked in April, the unemployment rate has steadily declined and was down to 6.7 percent in December 2020 [6]. Despite this significant recovery, U.S. unemployment is still more than double the rate in February before restrictions were put in place. Furthermore, the speed of the recovery began to wane in November due to the emergence of new variants of the virus, further business restrictions, and the consequent slowdown in the recovery of labor markets [67].

It is also important to note that, due to the pandemic, many jobless people who would normally be looking for a job have remained out of the labor force due to factors including fear of contracting the virus and a perception of job shortages due to the economic downturn. In addition, many people who would like to work full-time are accepting part-time positions, either because their hours were cut back or because they are struggling to find full-time employment. The Bureau of Labor Statistics (BLS) U-6 measure of unemployment accounts for these workers and is considerably higher than the measure used as the official unemployment rate, U-3, which only includes people who have neither full-time nor part-time jobs and who have sought work in the past four weeks [68]. Figure 4 shows that both unemployment

measures peaked in April, began to decline in May, and levelled out from September to November. Importantly, Figure 4 also shows that the U-6 unemployment rate increase to the April peak was steeper than the U-3 unemployment rate increase and the difference between the two remains greater than it was prior to the April peak. This shows that the pandemic has resulted in greater than usual numbers of people who are jobless and not looking for work or who are working fewer hours than they would otherwise prefer.

While an end to the pandemic is expected to result in significant recovery to the labor market, recovery is unlikely to be immediate or complete. A study from the Peterson Institute for International Economics finds that even if all furloughed workers were immediately given their jobs back, unemployment would still be higher than it was before the pandemic [26]. Looking at historic data from past economic downturns in the United States, only around 70 percent of furloughed workers return to their jobs [69]. The relatively slow recovery of the labor market seen in the first month of 2021 supports this expectation for slow and only partial recovery. In January, the BLS reported that while the unemployment rate fell by 0.4 percent, the labor force participation rate remains two percent below pre-pandemic levels [70]. Speaking to the broader labor force participation decline, Chair Jerome Powell of the Board of Governors of the Federal Reserve indicated in a February address that the U.S. labor market has a long way to go to full recovery. According to Powell, “[f]ear of the virus and the disappearance of employment opportunities in the sectors most affected by it, such as restaurants, hotels, and entertainment venues, have led many to withdraw from the workforce” [2]. Data shows that at least five million Americans cited the pandemic as the driving force behind why they were not looking for work in January. A soon-to-be released study by the McKinsey Global Institute predicts that even post-pandemic, business travel will be reduced by 20 percent compared to pre-pandemic levels and 20 percent of workers will work continue from home indefinitely, resulting in fewer jobs at hotels, restaurants, and shops [71].

FIGURE 4: U.S. UNEMPLOYMENT RATE THROUGH NOVEMBER 2020



This chart shows the fluctuations in the U.S. unemployment rate nationally through November 2020 with the high point reached in April.

Source: Bureau of Labor Statistics [3, 72]

Adding to the lasting nature of the pandemic’s impact on employment is the fact that many job losses due to pandemic are expected to be permanent, as businesses close and the public sector is forced to make large budget cuts. These cuts lead to job losses without federal government providing significant support for state and local governments, a sector which employs a relatively larger number of workers from communities of color [73]. As of November 2020, 14.8 million people reported that they were unable to work because their employer had closed or lost business [3]. A survey conducted in April 2020 by Main Street America on more than 5,850 small business owners across the country found that 7.5 million small businesses are at risk of closing permanently due to the pandemic, putting 35.7 million Americans at risk of near-term unemployment [74]. In the May iteration of the Small Business Pulse Survey, the U.S. Census Bureau reported that more than half of the survey respondents indicated their business had faced large negative impacts from the pandemic and that it would take more than six months for full recovery [75]. Through August 2020, small business revenue across the country was estimated to be down by at least 20 percent [1]. In the September Local Economic Impact Report, Yelp found that more than 160,000 businesses had closed due to the pandemic. At least 60 percent of these businesses were permanently closed with larger states and metro areas experiencing the most significant impacts [76].

There are some signs that small businesses are beginning to recover. Data collected by the Census Bureau in the second half of 2020 show a declining number of respondents indicating “large negative” impacts to their businesses. At the beginning of January 2021, only 30 percent of respondents nationwide reported this level of impact [77]. Some of this improvement is tied to the relative success of the Paycheck Protection Program, which was funded with \$669 billion through the CARES Act and offers forgivable loans to businesses with fewer than 500 employees [78]. In his February address, Jerome Powell cites several

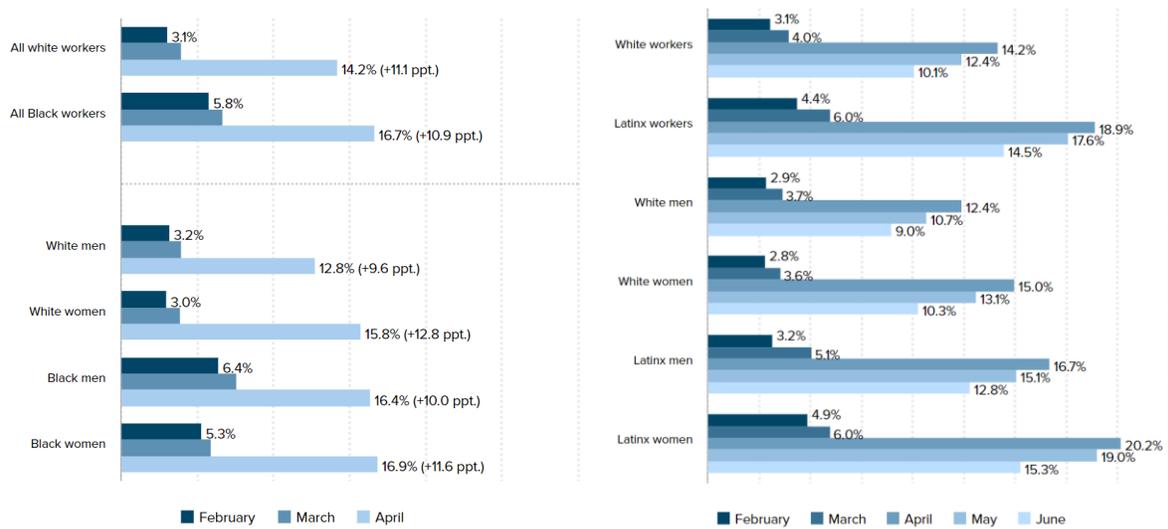
studies that provide evidence for the high success of the program in keeping businesses afloat and supporting employment throughout the pandemic [2]. The number of businesses reporting decreased revenue dropped from 70 to 40 percent between May 2020 and January 2021. Assistance is still likely needed and the Biden Administration has pledged \$15 billion in direct grants to small businesses as a part of its proposed \$1.9 trillion America Rescue Act [79].

Job losses have not been evenly distributed across sectors either. According to the BLS data, the Leisure and Hospitality sector faced the largest job declines since February. The sector saw more than 3.9 million lost jobs through December, 23 percent lower than the February level. Public sector jobs are also being cut at significant rates. More than 30,000 local government and 20,000 state government jobs were lost in December while federal employment rose by 6,000. Between February and December 2020, the Government sector lost 1.3 million jobs [7]. The Financial Times reports that one in six Black Americans are employed in government jobs and are disproportionately affected by layoffs in the public sector. According to the BLS, 130,000 state and local government workers lost their jobs in October 2020 alone [80]. Transit agencies, another arm of the public sector, also came close to being forced to make major budget and job cuts due to steep declines in revenue from lost ridership, as discussed in the *COVID-19 Impacts on Transportation* section above. Layoffs were largely averted due to the \$900 billion federal pandemic relief package passed in late December [53, 81].

Pandemic-related job losses, like many of the country's challenges, are having a disproportionate effect on underserved groups including Black and Latinx communities. The Economic Policy Institute (EPI), a nonprofit focused on issues relating to equity and economic policy, explains, "The disparate racial impact of COVID-19 ... should come as no surprise given the ongoing legacy of racism that continues to produce unequal outcomes affecting nearly every aspect of life in the United States [9]." Two reports from EPI highlight evidence supporting the conclusion that both Black and Latinx workers face worse economic outcomes due to the pandemic than white workers [9, 10]. The reports highlight data from the Bureau of Labor Statistics to compare unemployment rates among Black men and women, Latinx men and women, and white men and women, revealing higher unemployment rates in all racial categories compared to white counterparts. These data from the report are summarized below in Figure 5. The reports also point to other ways in which the pandemic is disproportionately affecting Black and Latinx workers, including inequalities in the ability to work from home, ability to pay rent during the pandemic, limited cash reserves, higher uninsured rates, and many other factors.

Looking specifically at the auto industry and the clean vehicle manufacturing sector in particular, unemployment soared in the early months of the pandemic as a result of extended production shutdowns and lower consumer demand for cars. Reports from the Bureau of Labor Statistics and independent researchers found that employment in the clean vehicles sector of the auto industry was down 15 percent while the auto industry overall saw a 30 percent drop as production shutdowns were in place through June 2020 [24]. Declining employment mirrored declining auto sales throughout the country. Despite a strong recovery from September through December, U.S. passenger EV sales were down three percent compared to 2019 levels. The U.S. auto sector overall saw a sales decline of 15.6 percent in 2020 with many flocking to the used market due to factors including higher prices for new cars as a result of production delays and limited supply [82, 83]. Another factor influencing the boost in used car sales is shifting travel patterns due to the pandemic [84]. Analysts link declining transit ridership and income loss as two factors driving steady demand in the used vehicle market [85]. Cox Automotive estimates that used car prices were up 15 percent year-over-year as of September, driven by a surge in used car sales in 2020 [86].

FIGURE 5: UNEMPLOYMENT RATES BY GENDER AND RACE THROUGH APRIL AND JUNE 2020



These charts show differentials in the unemployment rates across gender and race in the United States. Women and communities of color face higher levels of unemployment compared to white men throughout the worst months of the pandemic.

Source: Economic Policy Institute [9, 10]

The vehicle market is far from the only sector that faced significant challenges in 2020 and swift economic recovery will likely require additional federal support on top of the \$900 billion relief package passed in December. Investment in transportation electrification has the potential to provide essential support and create manufacturing and supply chain jobs in the United States. Additional economic recovery opportunities related to transportation electrification are discussed below in the *Overview of Existing Regional, State, and Federal*

Transportation Electrification Actions section and will be a focus of the second paper of this series.

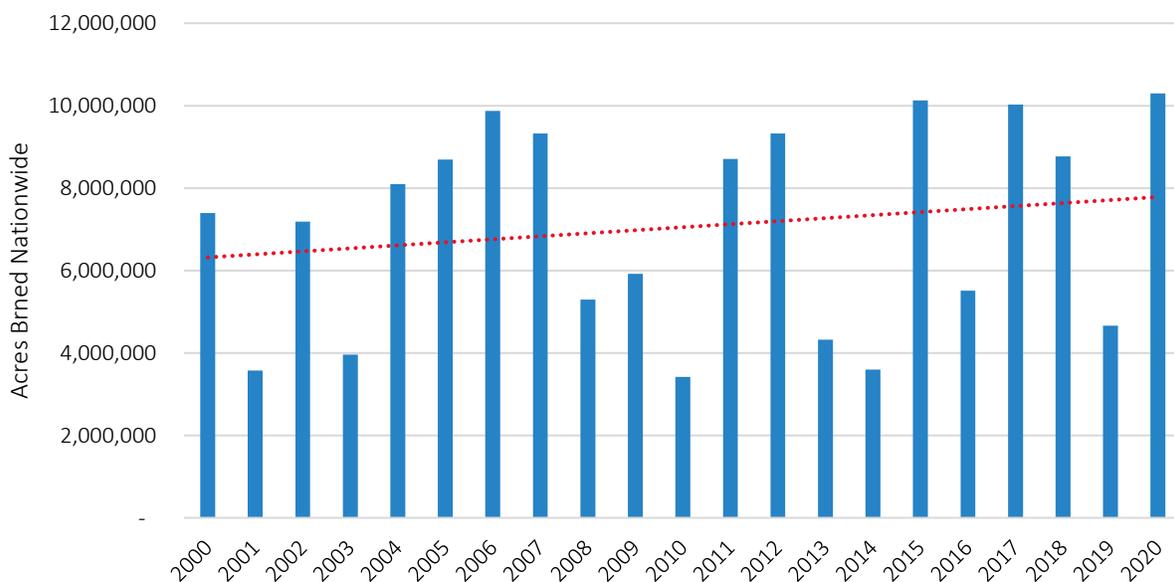
WILDFIRE IMPACTS ON AIR QUALITY, CLIMATE CHANGE, AND THE ECONOMY

WILDFIRE IMPACT ON AIR QUALITY AND CLIMATE CHANGE

Western states struck by the pandemic have also had to contend with a particularly brutal wildfire season throughout 2020, bringing additional air quality and climate change challenges. Record breaking wildland fires have been recorded from New Mexico to Washington and have touched every state in between.

Wildfires have historically been the leading source of criteria air pollutants in the United States. Through December 2020, at least 10.3 million acres across the country have burned [87, 88]. This is roughly double the 10-year average reported by the National Interagency Fire Center (NIFC) [89]. Research from the American Geophysical Union estimates that wildfire burn area has increased by eight times across western states since the 1980s and that the primary driver of increasing fire severity is human-caused climate change [90]. Recent reports from the National Oceanic and Atmospheric Association confirm this finding and have found that climate change in the Arctic including Alaska is increasing the amount of land area susceptible to annual wildfires [91]. In 2019, Alaska accounted for more than half of the nation’s total burned area [89].

FIGURE 6: U.S. WILDFIRE BURN AREA FROM 2000 THROUGH 2020



This shows the annual total number of acres burned by wildfires nationwide over 20 years. So far, 2020 is the most severe fire year in the 21st century followed by 2015 and 2017. A trendline is included to show the increasing burn area in the last two decades.

Source: NIFC [12]

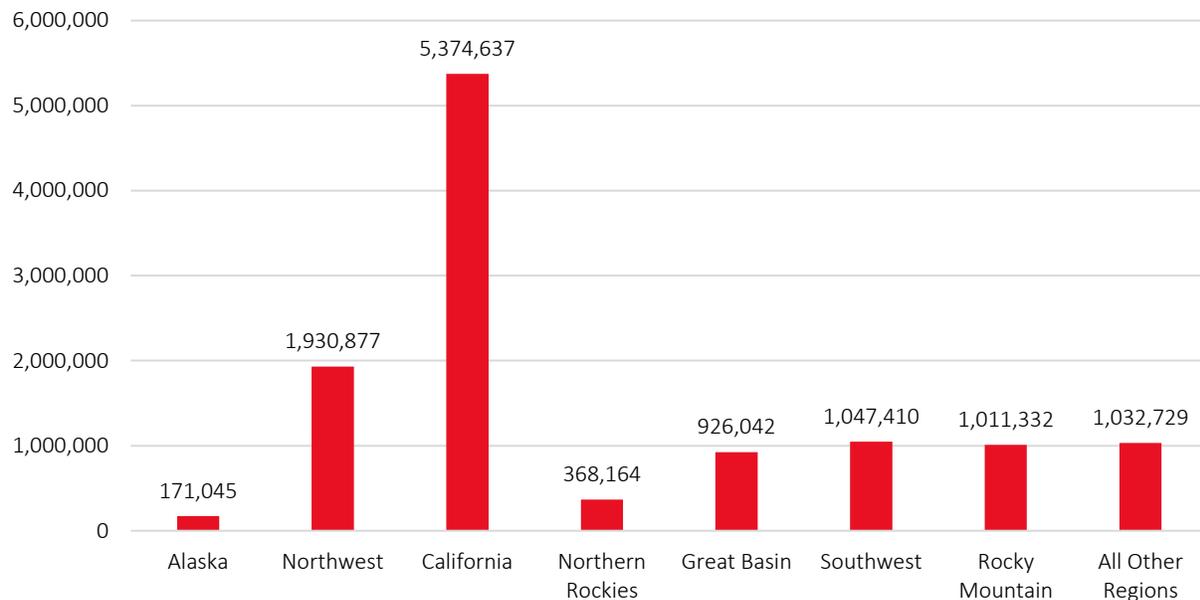
California dominated the fire conversation in 2020 with more than 40 percent of the nation’s burn area falling within its borders. The state saw five of its six largest fires on record in 2020 with active fires still burning into December [92]. For context, only 260,000 acres were reported burned in California in 2019 compared to more than 5 million acres in 2020 [93]. Nationwide, 2020 was the most severe wildfire season on record since 1952 and had the highest acreage burned of any year this century.

Oregon, Washington, and Colorado also experienced record fires in 2020. More than one million acres burned in Oregon in a string of fires that exploded in September, making 2020 the second-most severe season on record in the state. Washington also logged its second most severe wildfire season in the decade with between 500,000 and 800,000 acres burned in 2020 according to various sources [94, 95]. It took Colorado firefighters 2.5 months to reach 100 percent containment of the state’s largest fire on

AIR QUALITY, CLIMATE CHANGE, AND COVID-19

record, the Cameron Peak Fire, which started in mid-September. That fire alone burned more than 200,000 acres [96]. The remaining burn area was spread throughout other Western states with only eight percent of fires occurring in the eastern half of the country. Figure 7 shows the breakdown of 2020 burn area by region designated by the NIFC as of the last year-to-date reports filed at the end of December 2020.³

FIGURE 7: 2020 WILDFIRE BURN AREA (ACRES) BY REGION



Regions are determined by the National Interagency Fire Center and are as follows: Northwest (OR, WA); Northern Rockies (ID, MT); Great Basin (UT, NV, ID, AZ); Southwest (AZ, NM); Rocky Mountain (CO, WY, SD, KS, NE). "All Other Regions" influences all other states not listed in other regions, with a bulk of incidents coming from Texas and Oklahoma.

Source: NIFC [6]

Fires in 2020 generated significant emissions across affected areas. Researchers from the University of California at Davis estimate that 2020 California wildfires were second to only transportation in terms of CO₂ emissions [97]. Although the same researchers argue that the impact of emissions from wildfires on climate change are unclear, others note that long term forest loss and exposure of frozen carbon and methane in the arctic could increase the climate impact of wildfire emissions. While there are many ways to mitigate climate change and reduce greenhouse gas emissions, the electrification of the transportation sector is one of the most important pathways to offset emissions from wildfires [98].

The negative impacts of wildfires on public health through criteria air pollution are much clearer. A study from the New England Journal of Medicine notes that exposure to criteria air pollutants released when forests burn could have an even stronger negative impact on public health than exposure to urban

³ The 2020 summary report from NIFC was not available at the time of this report.

particulate matter [98]. Based on data from 2017, fires accounted for 25 percent of criteria air pollution emissions nationwide [3]. The portion of fine particulate pollution (PM_{2.5}) and particulate pollution (PM₁₀) associated with wildfires have been increasing over time. Between 2010 and 2019, wildfire's share of PM_{2.5} pollution rose from 17 to 29 percent. For PM₁₀, the share rose from six to 11 percent [4].

In California, the epicenter of wildfire smoke in 2020, farm workers were among those facing the highest levels of exposure to polluted air. These workers were forced to forego critical wages to avoid prolonged exposure to pollution [14]. As covered in the *COVID-19, Air Quality, and Public Health* section above, increases in particulate pollution have been found to intensify the risk of COVID-19 mortality. In certain rural communities in California, predominantly Latinx farmworkers make up 70 percent of COVID-19 cases [14]. The same risks have been recorded in Oregon and Washington with frontline communities citing a lack of support from state agencies to deal with the impacts of wildfire smoke, including loss of income due to the timing of fires right during harvest season [99, 13]. Houseless population in the urban west are another community facing increased exposure to both wildfire smoke and COVID-19. The more than 150,000 homeless individuals across California are predominantly people of color and are also on the frontlines of the coronavirus where large outbreaks are common in shelters [100].

STATE AND ELECTRIC UTILITY MITIGATION EFFORTS

Protecting the health of these vulnerable communities has fallen to the states who are working with stakeholders including electric utilities to address the increasing intensity of wildfires throughout the region. Western policymakers have enacted legislation and established task forces to devise comprehensive relief for their constituents. However, some key legislation relating to wildfire mitigation did not pass in the previous legislative session in Oregon and will likely be addressed in current or future sessions. Electric utilities are closely involved in many of these task forces along with the state agencies responsible for natural resources and forest management, emergency management, and many other stakeholders. Engaging utilities in wildfire mitigation has been a common practice in the west for several years with some of the region's largest fires originating from equipment failure. For example, California's largest fire on record, the Camp Fire of November 2018, was tied to equipment owned by Pacific Gas and Electric (PG&E) and the utility was found liability for the damages [101]. Claims for more than \$20 billion led the utility to file for bankruptcy and in March 2020, PG&E reached a deal with the state that led to an overhaul of the company's leadership and shaped the creation of the California Wildfire Insurance Fund [102].

The aftermath of the Camp Fire and subsequent incidents have increased electric utility coordination in California and other states. Utilities in California are required to file annual Wildfire Mitigation Plans which will be updated in early 2021. These efforts are overseen by the California Public Utilities Commission, which in 2019 was granted additional authority through Assembly Bill (AB) 1054 to enforce wildfire safety measures including equipment inspection and upgrades carried out by the state's utilities [18]. The legislation also established the Wildfire Fund, paid into by utilities, to reimburse claims against utility-caused incidents throughout the state [103]. AB 1054 also set up the Wildfire Safety Advisory Board and Catastrophe Response Council to meet regularly and coordinate between state agencies on mitigation and relief efforts. These efforts to increase engagement with utilities in fire mitigation feed into broader state

efforts established in 2015 with Senate Bill (SB) 246 establishing the Integrated Climate Adaptation and Resiliency Program (ICARP) to coordinate efforts across state agencies [104].

California agencies and utilities are not the only ones establishing working groups to tackle wildfire mitigation. In Oregon, Portland General Electric has coordinated with the Edison Electric Institute (EEI), the trade association for investor-owned utilities, to expand their risk assessment and mitigation programs in the 2019 Wildfire Mitigation Plan [105]. However, legislative actions in Salem have not gone as far as California in terms of requiring utilities to implement standard risk reduction measures. Governor Kate Brown's Wildfire Response Council released a report in September 2019 recommending a cohesive strategy to address the increased wildfire threat. The report included measures related to wildfire emergency response, land use and forest management and also included a role for utilities, particularly in ensuring preparedness and mitigation [106]. While the report resulted in the introduction of two bills, Senate Bill 1536 and House Bill 4168, neither bill was enacted into law with the necessary and recommended funding levels. However, Governor Brown responded with a rolled back version of the wildfire funding and relief mechanisms proposed in Senate Bill 1536 [107].

Utilities and working groups in states like Colorado have pointed to the fallout from the Camp Fire in California as motivation to expand their efforts in addressing increasing wildfire intensity in their territories. Studies show increasing numbers of Coloradans moving into foothill areas with greater wildfire risk, prompting Xcel Energy to conduct preemptive risk assessments and identify improvements that could reduce the damage potential of utility-caused wildfires by more than \$1.6 billion [108]. In Washington, utilities have come together under the Electric Utility Wildland Fire Prevention Task Force overseen by the Department of Natural Resources (DNR) to mitigate fire risk. The task force released their final report in December 2020, which establishes a strategy for managing vegetation that poses a high fire risk due to the proximity of transmission lines and other infrastructure. It also enhances resource sharing between the utilities and DNR to increase the educational opportunities around risk management [109].

While most of the key mitigation actions are being taken at the state level, utilities have taken certain actions to support legislative initiatives at the federal level as well. EEI established a task force on wildfire mitigation in 2019 in an effort to inform the practices of their member utilities [110]. One of the interventions the group is targeting involved enhanced monitoring systems to detect and address fire outbreak early on. Thomas Kuhn, the President of EEI, has also written to the U.S. Congress in support of the bipartisan Senate Bill 4431 [111]. Introduced in September 2020, the Emergency Wildfire and Public Safety Act of 2020 calls for expanded risk assessments conducted by the U.S. Forest Service, increase the use of new technology to monitor and control fire outbreaks, and expand restoration efforts in affected areas [112]. Other including the bill's co-sponsor U.S. Senator from California Dianne Feinstein have urged the passing of this bill, which calls for more coordinated support from the federal government in recognizing and addressing climate change as one of the primary drivers of wildfires in the west [113].

ECONOMIC IMPACT OF WILDFIRES AND NATURAL DISASTERS

In addition to compounding public health costs, states face increasing budgetary challenges with the spread of wildfires, exacerbating the economic challenges caused by the COVID-19 pandemic and amplifying the need for economic stimulus through investments such as transportation electrification.

Wildfire costs are often broken up into four subcategories: Preparedness, Suppression, Relief, and Insurance [114]. In terms of suppression costs in 2020 alone, the National Interagency Fire Center reported more than \$3.6 billion spent to contain wildfires and hurricanes throughout the country [6].

Beyond suppression costs, insurance companies have estimated the costs associated with damage to property throughout the western states. As of November, insurance losses already topped \$8 billion with estimates that economies in California, Oregon, Washington, and Colorado could take a \$13 billion hit by the end of the fire season [115, 116, 117]. Risk Management Solutions, the firm behind the analysis, estimates that Northern California faces the heaviest share of the damages with between \$5 and \$9 billion in losses. The analysis indicates that despite intense fires throughout the region in 2020, emergency power shutoffs and state programs providing relief have been effective in mitigating some of the potential economic fallout. While per person costs are highest in California due to high damage and large fires, for states with much smaller populations and fewer resources are also being hit hard. In Oregon, a state with 9.4 times fewer people than California, the estimated per person cost of the 2020 fires was only 2.7 times lower [118].⁴

Increasing losses by insurance companies have created tension in states like California where losses are piling up. Between 2018 and 2019, the number of policies dropped by insurers in the wake of wildfires increased by 61 percent according to the California Department of Insurance [119]. This has led the state to form the California Climate Insurance subdivision within the Department of Insurance. The commission has fought to prevent insurance companies from cancelling policies of homeowners in the aftermath of wildfires and developing frameworks for companies to adapt to increasing wildfire risk in the coming years [120] In 2020, Commissioner Ricardo Lara protected 2.4 million policyholders from cancellation representing roughly 20 percent of all policyholders in the state [121, 122].

At the federal level, more than \$183 billion has been spent on disaster preparedness and relief funding including wildfires, hurricanes, floods, and other extreme weather events since 2017 [123]. In general, the federal government tends to allocate a larger proportion of their spending to relief rather than preparedness. Analysis from USA Facts estimates that between 2005 and 2017, \$37 billion out of a total of \$81 billion spent by FEMA on disaster response was specified for preparedness efforts [124]. Due to the density of infrastructure in coastal regions vulnerable to hurricanes, the property damage associated with these events is typically higher than wildfire damages. In 2020, property damage from hurricanes is estimated at more than \$43 billion. Looking at historical data, the National Ocean and Atmospheric Administration has tracked more than \$1.75 trillion in damage from “weather and climate disasters” between 1980 and 2019 with the highest expenses tied to hurricanes [125]. Other reports connect the increasing frequency and intensity of extreme weather events like hurricanes and fires to the growing cost of climate change. Total damages in 2020 are estimated at \$95 billion, roughly double the amount in 2019 [126].

These disasters put considerable strain on utility and government budgets, potentially making it challenging to prioritize investment in technologies like EVs that help mitigate climate change. In addition to this, customers in states like California will be responsible for a portion of utility costs related to wildfire risk mitigation [127]. Increasing wildfire costs are creating significant economic challenges for utilities such as PG&E, which filed for chapter 11 bankruptcy in early 2019 due to wildfire damages [102]. In the case of California, one possible solution to reduce costs for electrical grid operation while also putting downward pressure on rates is transportation electrification. Updated analysis for June 2020 conducted by Synapse Energy Economics shows that for the state’s two largest utilities, increasing EV adoption and vehicle-grid

⁴ Estimated \$228 per person fire damage for California dividing \$9 billion in damage by 39.5 million people. Oregon costs of \$84 per person from \$354 million in damage divided by 4.2 million people.

integration programs designed to shift charging demand to off-peak times has led to \$800 million in revenue over costs between 2012 and 2019 [128]. In addition to providing savings potential for electric utilities, transportation electrification also has significant emissions and public health benefits, as outlined in the *COVID-19, Air Quality, and Public Health* section above. The opportunities for EVs and investment in clean transportation more broadly to provide pandemic stimulus and address the root cause of extreme weather like wildfires is outlined in the following section.

OVERVIEW OF EXISTING REGIONAL, STATE, AND FEDERAL TRANSPORTATION ELECTRIFICATION ACTIONS

Transportation electrification can be an essential part of the suite of solutions to the urgent, public health, and social and economic justice challenges exacerbated by the pandemic and increasingly severe wildfires. The pandemic continues to impact underserved communities at a disproportionate rate through both public health impacts and job losses. Emphasizing the deployment of electric vehicles operating in underserved areas can be a constructive step in the design of government and utility programs designed to address these challenges. In addition to expanding targeted programs with a clear environmental justice focus, statewide and regional initiatives are equally important to achieve the emissions reductions and overall public health benefits provided by decarbonizing energy and transportation systems.

Public agencies, private companies, and utilities EV sales-leading states like California, New York, New Jersey, and Colorado have all taken steps to commit significant funding to transportation electrification while also prioritizing the public health of underserved communities. On January 5, 2021, Governor Gavin Newsom proposed a \$4.5 billion Equitable Recovery for California's Businesses and Jobs plan that includes \$1.5 billion for transportation electrification investment. Part of this funding will include support for Clean Cars 4 All Program that will help reduce the cost of EV adoption for low-income drivers [129]. Across the country, New Jersey continues to exhibit strong leadership around climate and clean technology investment with the establishment of the new Office of Climate Action and the Green Economy in an executive order issued on February 16th 2021 [43]. The order included \$100 million in new grant funding for transportation electrification with a focus on underserved communities. New Jersey has also seen the approval of more than \$180 million in utility investment in transportation electrification in the first two months of 2021 [130].

California and New Jersey have committed to transportation electrification on a transformational scale and both states in addition to Massachusetts are the first in the country to set targets to achieve 100 percent zero emissions passenger vehicle sales by 2035 [131, 132]. In September 2020, Governor Gavin Newsom cited the ongoing public health and climate crisis facing underserved communities arising from both wildfires and the pandemic as key justifications for accelerating the move to zero emission transportation [133]. This commitment follows on the heels of the landmark Advanced Clean Trucks Rule, enacted in June 2020, and the Multi-State Medium- and Heavy-Duty Zero Emission Vehicle MOU signed by California and 14 other states in July 2020 seeking 100 percent ZEV sales of trucks and buses by or before 2050 [134]. Achieving these targets will require significant charging infrastructure build-out along with complementary policies such as fleet purchase requirements, vehicle purchase incentives, utility

support for charging infrastructure, supportive electricity rates such as rates that encourage off-peak charging or help overcome barriers associated with demand charges, and education and outreach. With the right suite of policies and investments, the state could reduce greenhouse gas emissions in the state by 35 percent and slash emissions of criteria pollutants like NO_x by up to 80 percent. Racial and economic justice groups like the Greenlining Institute applauded this progress and continue to call for increased prioritization of disadvantaged communities in the implementation of transportation electrification programs in the Golden State [135]. Other MOU signatory states including New York, New Jersey, and Colorado have established recurring state tax credit and rebate programs to offset the cost to purchase medium- and heavy-duty vehicles. Each of these states have been among the most proactive in seeking to ensure that all communities benefit from the forthcoming transportation electrification and COVID-19 recovery plans.

Electric utilities and private companies are also increasing their investment in transportation electrification. The potential for more utility investment is even higher with industry leaders like Xcel Energy in Minnesota awaiting approval of a \$157 million COVID-19 recovery plan that was proposed in June 2020. North Carolina, which had not seen any approved utility investment, saw its first approval for \$25 million in November 2020 where Duke Energy was directed to work with stakeholders and public agencies in the state to leverage Volkswagen Settlement funding and other resources to increase the scope and impact of transportation electrification programs in the state [136]. In the private sector, money is flowing to EV technology through several new public offerings from EV and EV charging companies in 2020 and early 2021. The recovery of U.S. EV sales in the second half of 2020 coincided with a surge in investment commitments. Automakers, startups, and other manufacturers have pledged more than \$45 billion in new investment towards their EV operations in the United States between July 2020 and February 2021 [137]. Ford increased the previously planned \$11 billion commitment to \$29 billion in February 2021. The automaker also pledged to electrify all sales in the European market by 2030, similar to General Motors' aspirational goal made in January to electrify all global sales by 2035 [138]. For their part, General Motors also expanded their initial commitment of \$20 billion in November 2020, adding an additional \$7 billion to their EV investments, including a \$2 billion retooling of an EV plant in the emerging EV manufacturing center of Tennessee announced in October 2020 [138]. These investments have created regional hotspots where strong manufacturing bases in the Southeast and the Midwest bringing increased attention to the role of transportation electrification as an economic driver to spur domestic auto manufacturing [24, 139].

Federal policy may also have an important role to play in supporting transportation electrification in 2021. The Biden administration has made clear that transportation electrification will be a priority and as Washington looks to pull the country out of the pandemic-induced economic and public health crisis. The federal government can look to Europe for the results of what can happen if transportation electrification is prioritized in stimulus plans. Supportive policies encouraging EV adoption have ignited the European passenger EV market, which grew by at least 170 percent in 2020 compared to 2019, despite the pandemic [140]. In December 2020, the European Union announced new goals to deploy 30 million EVs by 2030. There are currently around 1.8 million passenger EVs registered in EU member countries, similar to the number of all-time sales in the United States since 2010 [141].

While the global auto market was down 14 percent in 2020 as a result of the pandemic, EV sales were up 39 percent [142]. EV sales in the United States were down three percent in 2020 compared to 2019, indicating that growth was driven by other regions [138]. This strong performance has backed

expectations that the global EV market will grow by 50 percent in 2021 [143]. The United States has relinquished its leadership position in EVs to China and Europe in recent years and risks falling further behind if transportation electrification is not prioritized in stimulus plans and recovery packages. While the \$2 trillion Coronavirus Aid, Relief, and Economic Security (CARES) Act passed in March 2020 included \$25 billion in assistance to transit agencies, the bulk of federal spending has been focused on emergency relief without any clear carveouts for clean energy or transportation [48]. This is also the case with the \$900 billion relief package passed in December, which includes \$14 billion in direct support for transit agencies to prevent layoffs and service cuts.

The second paper of this series will focus on the role of transportation electrification in economic recovery, describing best practices from utilities and state governments as well as lessons learned from the American Reinvestment and Recovery Act of 2009. It will also consider the events in the early days of the Biden administration and outline the most available pathways toward a transportation system rooted in environmental and economic justice for all Americans.

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