



**Mobility, Technology and Safety: The Next 20 Years**

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This report was commissioned in 2021 by the National Safety Council (NSC) to understand the potential evolution of transportation technologies over the next 20 years and their implications for traffic safety in urban areas. The National Safety Council, America’s leading nonprofit safety advocate for more than 100 years, recognizes the urgent need to address the recent spike in roadway fatalities and prepare for a safer mobility future. *Mobility, Technology and Safety: The Next 20 Years* aims to explore what the ever-changing world of mobility means for safety advocates and supplement ongoing efforts.

This report contains (linked below):

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Allstate has been a steward for safe driving since the earliest days of the company. It is an indelible part of our legacy. But as the personal transportation evolves, so must our advocacy. Emerging trends and technologies in the transportation space compel not only us but the entire ecosystem to think more broadly about what constitutes roadway safety and how to advocate for it most effectively. This report, funded by Allstate and conducted by the National Safety Council, does just that by imagining the future of mobility in the coming decades and assessing the safety implications of it – not only for drivers, but for passengers, pedestrians, and users of emerging mobilities.

## Executive Summary

This report was commissioned in 2021 by the National Safety Council (NSC) to understand the potential evolution of transportation technologies over the next 20 years and its implications for traffic safety in urban areas.

Recent history shows the value of such forward-looking analysis. Over the previous 20 years, waves of new technologies have disrupted urban transportation, from carshare and ride hail to e-scooters and bikeshare. Public officials (and many advocacy groups) were caught off guard by this unprecedented rate of technological change, and they were often unsure how to respond to safety concerns that emerged. Preparing in advance for the next generation of transformative technology can save lives.

As we consider what the future of technology might bring, we must also address the current surge in roadway deaths. Traffic fatalities have spiked during the COVID-19 pandemic, with cities such as Austin and Portland setting new records. Despite the popularity of Vision Zero campaigns among elected officials, America's street safety crisis seems only to be growing worse.

In response, Congress took a crucial step toward reducing roadway deaths with its passage of the bipartisan infrastructure law (IIJA) in 2021, which boosted safety-oriented spending through novel initiatives like Safe Roads for All. The Department of Transportation has also made critical progress, including issuing the groundbreaking National Roadway Safety Strategy in January of 2022, which for the first time committed the federal government to a goal of zero roadway deaths.

This report is intended to supplement and add momentum to these ongoing federal efforts.

### Scope and Design

The lead author for this report was David Zipper, a Visiting Fellow at the Harvard Kennedy School with a background in both technology and local government, and the author of over 75 articles about cities, transportation and technology. Research included interviews with over 25 leaders from academia, the private sector, city and federal government agencies, and street safety nonprofit organizations.

The report's scope was limited to urban surface transportation technology over the next 20 years. Potential safety issues arising from the movement of people and goods on streets, sidewalks, and dedicated lanes were all included within the analysis; aviation and rural concerns were not.

The full report is broken into four sections (this executive summary captures key conclusions):

Section 1: History of Mobility and Safety: This section draws lessons from 200 years of urban mobility technology in the United States, examining patterns of safety challenges and regulatory

issues spurred by the emergence of new urban transportation form factors and technical capabilities.

Section 2: Trends of the Next Two Decades: This section offers an overview of technological, regulatory and business forces that will guide the development and deployment of new urban mobility technologies in the future.

Section 3: Form Factor Evolution: This section describes the potential evolution of existing urban mobility form factors (cars, bikes, transit, etc.) over the next 20 years, as well as the emergence of new ones. Likely safety challenges are highlighted throughout.

Section 4: Future Conflicts Among Street Users: Bringing together the previous three sections, this concluding section offers a utopian and a dystopian vision of urban transportation and safety in 2040, and then examines specific tensions that could arise within general traffic lanes, sidewalks, curbs, dedicated lanes and parking lots, respectively.

A summary of interviewees and works cited is included in the Appendix.

## **Key Conclusions**

### *1) Motor vehicles will remain the top source of street deaths*

Cars and trucks are involved with the vast majority of traffic deaths in urban areas, including virtually all deaths among cyclists, pedestrians and scooter riders. The trend toward heavier, taller SUVs and trucks is an ominous one for street safety – particularly because those vehicles will grow even heavier with electric batteries (the Hummer EV weighs over 9,000 lbs, over 2,000 more than its gas-powered version). While new micromobility devices like super-fast e-bikes will bring risks, their light weight and slower speed make them comparatively benign.

The federal government has done virtually nothing to restrain the weight and height of cars and trucks. Overdue revisions to the New Car Assessment Program (NCAP) and the Federal Motor Vehicle Safety Standards (FMVSS) that incorporate Vulnerable Road User (VRU) safety could help. VRUs are in the most need of protection, not only because they are physically exposed to motor vehicles, but also because automakers are not incentivized to protect people who are not buying their products (a longstanding challenge to street safety in the United States). Education programs targeting drivers may make sense, but those targeting VRUs risk blaming the victim.

Safety advocates should push for auto design improvements that enhance VRUs' safety, as well as stronger enforcement measures against habitually reckless drivers.

### *2) Widespread Advanced Driver Assistance Systems should be expected- but not autonomous vehicles*

Despite corporate predictions, no one interviewed for this report expects autonomous cars and trucks to be widely available in American cities by 2040. Urban environments contain too many “edge cases” – imagine a woman shooing birds away with a broom – that machine learning cannot reliably handle.

One potential way to hasten autonomous vehicle (AV) deployment would be to simplify the urban landscape by physically restricting pedestrians and cyclists from streets dedicated to cars. Such efforts bring to mind the creation of “jaywalking” as a crime 100 years ago. They should be resisted.

Although AVs have dominated popular discussion, Advanced Driver Assistance Systems (ADAS) are more likely to transform urban safety discussions in the coming years. As ADAS improves and becomes standard across American automobiles, features like automatic emergency braking and pedestrian detection can save lives (the average American car is now 12 years old, suggesting that vehicles without ADAS will remain on our roads for many years to come – and underscoring the importance of protective urban infrastructure).

Supporting ADAS development through thoughtful NCAP and FMVSS standards should be a high priority for safety advocates; catalyzing AVs’ arrival should not.

### *3) Climate change will fundamentally alter urban transportation*

As climate change worsens, “extreme” events like forest fires, hurricanes and blizzards will become more frequent. Evacuations will strain transportation networks, particularly if urban populations shift toward electric vehicles that require time to charge. Cities will also need to build resilience into vulnerable urban infrastructure (like the New York City subway) and ensure that residents without a car are able to evacuate safely.

Politically, climate change will fuel additional skepticism about the role of urban automobiles (transportation is the largest source of emissions in the United States). More cities may follow examples like central Oslo or New York City’s 14th Street, declaring streets and even entire neighborhoods to be car-free. Other cities will likely take more incremental steps, like increasing the cost of parking.

Anticipating the growing saliency of climate change approaches, safety advocates should highlight specific steps that cities can take to reduce both emissions and traffic fatalities (such as building protected bike lanes or providing late night transit service to encourage mode shift away from driving).

### *4) Denser neighborhoods will experience faster change in urban transportation technology*

Dense neighborhoods induce more short trips, and they are likelier to have high-quality networks of bike lanes and sidewalks. As a result, innovations such as trikes and sidewalk robots will scale faster in denser cities and neighborhoods (which, notably, could be in the suburbs or small towns) than in more sparsely developed communities. Parcel delivery, in particular, becomes more feasible on an e-cargo bike or drone in a dense neighborhood. Congestion at the curb could become a growing problem in such areas.

Cities are already experimenting with technologies that could improve management of on-street parking and loading zones. Safety advocates, states and the federal government should support these pilots, publicize encouraging results and codify best practices (and avoid preemptive laws that stymie the learning process).

#### *5) Parcel delivery is poised for disruption*

While ride hail and micromobility have reshaped passenger transportation across many American cities during the past 20 years, the surge in online shopping (and the growing antipathy toward delivery vans) could lead last-mile parcel delivery to be similarly upended in the coming two decades.

Especially if cities move to charge companies for curb access (or ban delivery vans outright, as has happened in Europe), technologies like cargo bikes, street delivery drones and sidewalk robots could become commonplace – especially in dense cities and neighborhoods. These new devices risk overwhelming existing street and sidewalk infrastructure.

Safety advocates should work with city and state officials to ensure that business interests are not prioritized over the safety of urban residents.

#### *6) Urban vehicles should be regulated by size and speed (rather than form factor) to encourage safety as well as innovation*

In the coming years, vehicles like 35-mph e-bikes and three-wheeled “trikes” will blur the lines between categories like “car,” “motorcycle” and “bicycle.” Rather than constantly revise their definitions, regulators and cities could set parameters based on weight and size for vehicles permitted in a given lane (such as a bike lane or arterial). As long as a vehicle is within those parameters, it can be assumed to be legal.

Such an approach would encourage innovation (since the private sector would know *ex ante* how a future device would be regulated) and enhance safety by reducing disparities in size and speed in the event of a collision.

Pivoting away from form factor regulation will raise a host of implementation challenges for local and state officials. Safety advocates should serve as a guide, sharing best practices, offering legislative templates and holding training sessions.

*7) Street rules should not be made to promote or enable a particular technology*

American cities made catastrophic mistakes in the early 20th century when they shrunk sidewalks, created the new crime of “jaywalking” and disinvested in transit – all in order to ensure automobiles could travel quickly throughout urban areas. Many city leaders today recognize the costs of those blunders and are searching for ways to mitigate them.

The history of early automobiles offers a warning about the risks of reshaping policy or infrastructure to enable new and specific technologies, whether it be providing scarce curb space to public EV charging or restricting pedestrian access to offer autonomous vehicles simplified urban environments.

Should conflicts emerge between the interests of street users and technology companies (such as sidewalk drones that jeopardize the access of those using wheelchairs), advocates and policymakers should stand with the people whose mobility is under threat.

*8) Cities should be able to manage their streets and sidewalks*

Since urban mobility technologies will generally be used within city or county boundaries, local officials should determine whether and how those technologies are regulated. But since the early 2000s, companies have successfully lobbied state legislators to block cities from regulating transportation, such as ride hail vehicles and sidewalk drones. Such preemption efforts constrain cities’ ability to protect residents, particularly when business interests come into conflict with public goals. As an example, Illinois is one of the few states where cities can still regulate ride hail themselves. That power enabled the city of Chicago to impose a fee on daytime trips that occur downtown, where transit access is readily available.

Because preemption often worsens safety risks, safety advocates should push back against proposals that curtail cities’ ability to manage their right of way.

*9) Revisions to infrastructure and policy will be essential to enhance safety even in the best case of technological improvement*

Although exciting new mobility technologies attract media attention and investment dollars, many of the most compelling opportunities to improve urban street safety lie in mundane policy approaches like extending sidewalks, building protected bike lanes and imposing road diets. To reduce road deaths, we need better policies and street designs as well as innovative technology products like ADAS.

Private companies will ensure that government officials recognize the potential safety benefits of their products, but infrastructure and policy solutions like sidewalks or slow lanes may get less attention. Safety advocates should focus on those solutions that would not otherwise rise to the fore during safety discussions.

*10) Protecting Vulnerable Road Users will support equity goals*

In urban areas nationwide, low-income and minority households are less likely to have regular access to an automobile and are more likely to die as a pedestrian or cyclist in a crash. By focusing on protecting Vulnerable Road Users (for whom motor vehicles are the greatest threat), safety advocates can support goals of providing safe mobility across disadvantaged communities.

## Section 1: History of Urban Mobility, Technology, and Safety

### Summary

Throughout American history, new urban mobility technologies have been met with suspicion. Vehicles like the bicycle and shared electric scooter were initially banned in many places, and the first purchasers of automobiles often faced angry neighbors and hostile local officials. Today, prototype autonomous vehicles elicit comparable wariness. Modes that do receive rapid acceptance tend to be those like ride hail and the electric bicycle that appear comfortably familiar (to the taxi and bicycle, respectively).

Safety is often cited as a reason to constrain or ban emergent mobility technologies. Sometimes these concerns are valid (such as the surge in pedestrian fatalities caused by automobiles a century ago) but in other instances safety is a fig leaf, concealing the real motivation of critics: maintaining incumbent modes' access to scarce urban street and sidewalk space. There is at most a loose correlation between the ferocity of pushback against a new technology and the actual safety risks it poses (i.e., the forceful opposition to shared e-scooters seems disproportionate to their actual risk). Also notable: new forms of urban transportation often emerge with relatively high price points, targeting affluent city travelers before growing more affordable and finding wider adoption.

### Technology Innovation Before the Automobile

The history of mobility technology revolves around goals of expanding the “isochrone” of places reachable within a [30-minute commute](#) or (less often) providing more enjoyment during the trip itself.

Prior to the Civil War, urban transportation typically involved walking, using an omnibus (a horse-drawn carriage with multiple passengers), or a horse. Street access was generally open to all users – be they pedestrians walking to work, children playing, or an omnibus conveying commuters. One early form of urban mobility regulation involved the draisienne, an early form of bicycle used more for fun than for transport, which became briefly popular among affluent city dwellers in the early 1800s. Numerous cities like New York limited its use, ostensibly on safety grounds.

The electric streetcar was first introduced in [Richmond, Virginia](#) in 1888, and its financial success led entrepreneurs to launch streetcar lines in virtually all American cities over the next two decades. Offering a faster and more economical way to travel, the streetcar extended the isochrone of daily commutes, driving urban expansions and real estate speculation. Streetcars

rapidly become the dominant mode of city transportation, providing as much as 80 percent of urban trips in the early 1900s.<sup>1</sup>

The ascent of the bicycle in the late 1800s was equally rapid – and more controversial. Early bicycle models after the Civil War had an oversized back wheel (so-called “penny-farthings”), which made them expensive and cumbersome to use on city streets. The safety bicycle, comparable to bikes in use today, emerged in the 1870s and 1880s, becoming wildly popular among young men and women in the years before the turn of the century. Cyclists launched the “Good Roads” movement of the late 1800s, the first lobbying push for paved roadways outside of cities.

Not everyone was enamored with these new two-wheelers. While streetcars were used by a huge swath of urban residents and workers, early bicyclists tended to be young, affluent, and relatively well-to-do. An urban backlash focused on speeding cyclists, so-called “scorchers,” accusing them of endangering people on foot. Trustees of New York’s Central Park sought to restrict cycle use on the grounds that the bikes scared horses, until cyclists tapped their growing political clout to demand permissive state rules that superseded local ones. Such instances of states preempting local authority with a new mobility technology would become a common pattern in the decades to come.

Until World War I, city governments dominated urban transportation. States and the federal government spent relatively little on roads and streets, and their regulation of transportation technologies was negligible. Local officials had the power to restrain new technologies like the bicycle, and they effectively killed off the steam vehicle, a once promising mode of urban transportation powered by coal (city residents worried about pollution and the risk of a vehicle’s boiler exploding).

With the dawn of the automotive age, states and the federal government began to allocate more funding toward urban transportation – and to demand more of a say in its oversight.

### **The Automobile’s Arrival**

Innovators began tinkering with the forerunners of the modern automobile in the late 19<sup>th</sup> century, though the vehicles were exorbitantly expensive and used primarily for recreation rather than transportation. Still, they began to catch on – and to create new safety challenges. On September 13, 1899, 69-year old Henry Bliss was struck by a taxicab as he stepped off a streetcar in Manhattan, becoming [the first known fatality](#) of the automotive age (and an early warning about the dangers inherent to public space shared by motor vehicles and comparatively vulnerable pedestrians and cyclists). William Phelps Eno, a self-taught expert in traffic safety, codified a set of road rules designed to maintain traffic flow and minimize the risk of collisions (many of his

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<sup>1</sup> Fogelson, Robert. *Downtown*, p. 44.

innovations, such as one-way streets and right-side driving, remain commonplace today). Eno drafted New York City's much-copied traffic code in 1903.

As automobile quality improved and prices declined (especially after Henry Ford's introduction of the Model T), affluent and then middle-class Americans began to buy them in growing numbers. The ratio of Americans aged 15+ to registered automobiles plummeted from 6,254:1 in 1900 to 133:1 in 1910 before tumbling to 7.8:1 in 1920 (almost half of sales in the 1910s were Ford Model Ts).<sup>2</sup> These early automobiles worsened street congestion, since automobile trips increased faster than horse and wagon trips declined.<sup>3</sup>

As urban car trips grew, so did pedestrian fatalities—especially among children who were accustomed to playing in streets. During the late 1910s and 1920s cities installed memorials for traffic deaths and held marches calling for protection from automobiles (meanwhile the relative affluence of most drivers enflamed class tensions). Indeed, popular mourning of road deaths – and protests against cars – dwarfed contemporary commemorations such as the World Day of Remembrance.

The apex of the backlash came in Cincinnati, where residents voted in 1923 whether to require all cars within the city to install a speed governor set at 25 mph. The referendum failed, but it sparked fear within car companies, which moved quickly to shift auto regulation away from cities and toward the states, which they could more easily manage.<sup>4</sup>

Working with groups including the National Safety Council, automakers adopted a series of policy strategies to ensure that cars could attain rapid speeds within cities, a necessity in order to attract urban buyers. A new crime of “jaywalking” compelled pedestrians and children to stay out of streets except at crosswalks. Schools incorporated street safety into their curricula, reinforcing the new idea that streets were first and foremost for cars. Vastly expanded police forces learned to issue tickets for traffic violations to drivers as well as vulnerable road users (to nurture new habits, police often opted to shame jaywalkers by blowing their whistles instead of issuing tickets). The idea of street safety as a “shared responsibility” took root, brushing aside the vastly different risk posed by a car to a pedestrian than vice versa. Meanwhile, the automobile gave police new discretion to stop and search travelers, a power that was disproportionately deployed against minorities, as Sarah Seo has described in her book *Policing the Open Road*.

As car ownership grew, pushback from cities waned. Streetcars, run by heavily regulated public companies, struggled to compete with policy regimes stacked against them. Streetcar companies, for example, had to maintain their own rails—which were frequently blocked by automobiles—while taxpayer dollars were tapped to improve streets and arterials used by

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<sup>2</sup> Wells, Christopher. *Car Country*, p. 39.

<sup>3</sup> McShane, Clay. *Down the Asphalt Path*.

<sup>4</sup> Norton, Peter (2011). *Fighting Traffic: The Dawn of the motor Age in the American City*. MIT Press.

automobile drivers. With streetcar lines failing, the motor bus quickly emerged as a common urban transit mode.

Early automobiles were dangerous not only for those outside the vehicle, but also for the people inside them. With minimal safety regulations, “crumple zones” did not exist, and interiors were filled with knobs and edges that could injure or kill during a collision. In 1936 some 36,000 Americans died in traffic crashes, roughly the same as in 2019, by which time vehicle miles traveled had increased eleven-fold.<sup>5</sup> A 1935 Reader’s Digest article in 1935 titled “--And Sudden Death” highlighted these risks, becoming one of the most widely reprinted pieces in the magazine’s history.

In his landmark 1965 book *Unsafe at Any Speed*, Ralph Nader placed a spotlight on the dangers that automobile design posed to vehicle occupants. Nader criticized the cozy relationship between automakers and the state legislators who then managed automobile safety. A subsequent public outcry led to the formation of the National Highway Traffic Safety Administration (NHTSA) and a shift toward federal management of car safety. Nader was disappointed by NHTSA’s relatively collaborative posture toward the auto industry, but the federal government did force the standardization of seat belts and airbags across automobile fleets, and it launched the groundbreaking New Car Assessment Program to educate car buyers about models’ safety (and give carmakers an incentive to develop less dangerous designs). Notably, these automotive safety advances provided substantial benefits to automobile occupants, but not to those outside the vehicle.

The 20<sup>th</sup> century saw remarkably little change in urban transportation form factors after the internal combustion engine became the dominant power source. Vehicles continued to evolve, but other than the motor bus, it is difficult to think of an urban transportation mode in 2000 that was not widely available in 1925 (cars, taxis, subways, and bicycles were already widespread by that time).

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This relative stasis of transportation modes in the 20<sup>th</sup> century gave way to rapid upheaval in the 21<sup>st</sup>.

### **The Cambrian Explosion of Urban Transportation Technology**

Carsharing – pioneered by Zipcar in 2000—offered many urban residents their first taste of the “sharing economy,” giving them the chance to rent instead of own vehicles that mostly lay unused. Bikeshare emerged in the late 2000s, first with Capital Bikeshare in Washington, D.C. and Arlington, Va. The ascent of smartphones enabled the rise of ride hail, which led for-hire vehicle

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<sup>5</sup> NHTSA, *Motor Vehicle Traffic Fatalities and Fatality Rates, 1899-2020*  
<https://cdan.nhtsa.gov/tsftables/Fatalities%20and%20Fatality%20Rates.pdf>

trips to double from 2009 to 2017, even as taxi trips declined. By 2017 one in ten Americans used ride hail in a given month – an astounding statistic for a service that did not exist a decade earlier.<sup>6</sup>

After ride hail's emergence, rapid improvements in battery technology fueled the rocket like ascent of "micromobility" vehicles like scooters and bikes powered by electric. Benefitting from a torrent of venture capital dollars, the growth of e-scooters' exceeded even ride hail's adoption rates. After Bird offered the first shared e-scooter ride in Santa Monica in September 2017, ridership exploded to 38.5 million trips in 2018 and 88.5 million a year later.<sup>7</sup>

This sudden arrival of these urban mobility technologies caught most cities and regulators by surprise. Uber in particular pursued a strategy of launching in new markets without first obtaining permission from city officials, who were then forced to scramble to react. This approach put regulators in a bind, because ride hail seemed to affect public goals around congestion (worsening it), transit (reducing ridership), and safety (limiting drunk driving but also creating new risks for pedestrians and cyclists). Still, it was unclear what ride hail regulations would be appropriate—or even if cities would have the power to impose them.

If cities tried to impose restrictions, Uber and Lyft frequently turned to states to preempt local authority. The most notorious example was in Austin, where residents approved a proposal to require fingerprint checks for all ride hail drivers in 2016. Uber and Lyft subsequently left the city – but then went to Texas state legislators, who blocked Austin from regulating ride hail at all. Freed of the city's oversight, Uber and Lyft promptly returned. Only a handful of states (Illinois, New York, Oregon, and Washington among them) still allow cities to set policies pertaining to ride hail. Chicago has used its authority to implement an innovative tax that applies only on daytime trips downtown, which is well-served by transit, an approach that most cities would be unable to replicate.<sup>8</sup>

When lobbying for preemption, ride hail companies – like other transportation firms – often cite the difficulties of navigating a "patchwork" of local regulations. Such claims may make sense for vehicles that regularly traverse city or county borders like an autonomous car, but far less for others that are used within a given neighborhood, like a sidewalk drone. Either way, the patchwork argument can be used to shift regulatory power from cities and toward state officials who are more sympathetic to corporate claims.

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<sup>6</sup> Conway, Matthew Wigginton, Salon, Deborah and King, David A.. *Trends in Taxi Use and the Advent of Ridehailing, 1995-2017: Evidence from the US National Household Travel Survey*. <https://www.mdpi.com/2413-8851/2/3/79/pdf>

<sup>7</sup> Schneider, Benjamin. *U.S. Scooter Ridership Surged in 2019. Now What?* <https://www.bloomberg.com/news/articles/2020-08-27/how-big-was-2019-s-scooter-boom-and-what-s-next#:~:text=In%202018%20and%202019%2C%20scooter,biggest%20player%20in%20U.S.%20micromobility.&text=Scooter%20ridership%20increased%20from%2038.5,36.5%20million%20to%2040%20million>.

<sup>8</sup> Freund, Sara. *Chicago's New Ride-Hailing Tax Begins Now, and It's the Country's Highest Fee*. <https://chicago.curbed.com/2019/12/2/20992472/chicago-transportation-tax-uber-lyft-taxi#:~:text=All%20trips%20in%20a%20private,will%20be%20increased%20to%20241.25>.

Seleta Reynolds was a local official in the San Francisco Bay Area when ride hail emerged, and she grew frustrated by companies' refusal to share data about their impacts on the local transportation network. Appointed Director of the Los Angeles Department of Transportation in 2014, she was determined to have more leverage when the next mobility mode emerged. Expecting that technology to be autonomous vehicles, Reynolds began developing a data standard called the Mobility Data Specification which would allow the city to monitor vehicles' locations and activities in real-time. When shared e-scooters arrived unexpectedly in neighboring Santa Monica in September 2017, Reynolds and her Los Angeles colleagues pivoted MDS to fit the new form factor.

After several years of tension that pit city transportation managers against certain mobility companies as well as privacy advocates like the ACLU, MDS has become the standard for managing shared micromobility in almost all cities nationwide, and it may be applied to other form factors such as sidewalk drones and ride hail. One of MDS' key goals is to improve scooter safety by identifying popular micromobility routes that would benefit from protective infrastructure like cycle lanes.

Questions of safety have swirled around e-scooters since their arrival. Riding one does pose a risk of injury, especially for new riders, and vehicles splayed across a sidewalk can create hazards for those who are mobility-impaired. Still, the risks posed by e-scooters to other road users is negligible compared to cars, which weighs far more and travels much faster. Yet only shared e-scooters are subject to mandatory speed governors within urban areas.

Perhaps because their form factor is more familiar, e-bikes have not sparked a popular backlash comparable to e-scooters. However, the emergence of new, powerful e-bike models that can exceed the standard limit of 28 mph pose new questions, such as whether they should be regulated as a moped or as a bike (and whether they should be ridden in a bike lane or a general traffic lane).

Finally, it should be noted that the bulk of innovation around urban mobility during the last twenty years revolved around the movement of people rather than cargo. A few nascent package delivery modes have emerged in the United States, such as e-cargo bikes and sidewalk drones, but they remain relatively rare. However, the ongoing surge in online shopping could position package delivery to undergo the kinds of tumultuous technology changes in the coming two decades that passenger transport has in the last two.

## **Lessons for Safety**

The history of urban mobility technology provides several lessons that resonate today:

*New form factors often spark a backlash*

Unfamiliar form factors like the bicycle, automobile, and e-scooter met far more pushback from urban residents than e-bikes or ride hail vehicles that resemble bikes and taxis, respectively.

With limited street space available, city residents often identify with a group using a particular mode (“cyclists,” “drivers,” “pedestrians,” etc).<sup>9</sup> Members of such groups may unite against a new competitor, demanding the imposition of restrictions and rules that are disproportionate to actual safety risks. The result can be regulations that are biased in favor of incumbent modes, such as contemporary requirements that shared e-scooters – but not automobiles—be equipped with speed governors or warning signals when ridden on the sidewalk.

Applying those lessons to the future, it is possible that autonomous vehicles resembling traditional cars may not spur as much popular pushback as might be expected (or appropriate) given their impact on urban life. However, AVs that look new and different – longer, narrower, or in unfamiliar shapes – could encounter more resistance.

*Street rules should not be made to promote or enable a particular technology*

When private sector interests unite behind a new mode, they may be able to bend city rules in their favor. This is the lesson of the automobile’s emergence in the early 20<sup>th</sup> century, when auto companies successfully positioned growing pedestrian fatalities as a problem of street rules and individual education, rather than an indication that cars are not scalable within dense urban environments. Seeking to change course a century later, states like Virginia have recently decriminalized jaywalking—a “crime” invented to accommodate car speed—and others like California are considering it.

With the potential arrival of autonomous vehicles, the history of the automobile presents a warning about the risks of elevating the preferences of mobility technologies; early adopters above the safety needs of vulnerable road users. For example, will pedestrians crossing a street be penalized if they force an autonomous vehicle to pause, slowing its passengers’ journey?

Safety advocates should consider advocating for the safety of vulnerable road users, who have the most to lose (and the least lobbying power) when boosters of new mobility technologies push for rule changes.

*Cities are being preempted in the regulation of technology on their streets*

The last 150 years have seen a steady erosion of cities’ ability to manage transportation vehicles—including emergent ones—and a shift in power toward state and federal regulations. Although cities effectively killed off the steam vehicle in the 19<sup>th</sup> century, states and later the

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<sup>9</sup> Goddard, Tara (2016). Exploring Drivers’ Attitudes and Behaviors toward Bicyclists: The Effect of Explicit and Implicit Attitudes on Self-Reported Safety Behaviors. Ph.D. dissertation, Portland State University.

federal government restricted them from regulating automobiles (often at the prompting of the auto industry).

Over 40 states now oversee ride hail, affording cities little ability to collect data on trips, let alone impose restrictions on operators' deployment or practices. Pennsylvania, meanwhile, recently passed a rule<sup>10</sup> requiring cities to treat sidewalk drones weighing up to 550 lbs as pedestrians, upending a public-private agreement that had been reached in Pittsburgh.

The recent emergence of data tools like the Mobility Data Specification are intended to shift power back in cities' favor, but local governments remain vulnerable to state and federal legislators (and lobbyists) who seek a more permissive posture toward new transportation technologies. Safety advocates may wish to step in, offering support to cities that want to regulate for safety more aggressively.

*Vehicle companies mainly look out for safety of their users*

After much prodding from the federal government, auto companies finally standardized technologies like seat belts and airbags that have dramatically reduced fatality rates for people inside a vehicle. But over the last 20 years, automakers have shifted their product lines toward heavy, tall SUVs and trucks—and made those SUVs and trucks still heavier and taller—contributing to the growing death toll like pedestrians and cyclists who are *outside* the vehicle. Such VRUs are particularly numerous in urban areas, meaning that the crisis in pedestrian and cyclist safety is a disproportionately urban one.

Little evidence suggests that car companies will invest voluntarily in technologies that protect people outside the vehicle, because the costs of such features can seldom be recouped through a higher sales price. In the past, major safety technology breakthroughs have been driven by regulation, not voluntary corporate actions.

Cars are far more dangerous in cities than bikes, scooters, or other comparatively light and slow vehicles. But risks to VRUs from these alternative modes of transport are rising, particularly as a new class of super-fast e-bikes hits the market. There is no compelling reason to think that e-bike manufacturers will be any more concerned with safety of other road users than car companies historically have been.

Again, this may be a trend that warrants attention from safety advocates who can help protect those who do not use an automobile, leaving them vulnerable to those who do.

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<sup>10</sup> Deto, Ryan. *Pennsylvania Legalizes Autonomous Delivery Robots, Classifies Them As Pedestrians*  
<https://www.pghcitypaper.com/pittsburgh/pennsylvania-legalizes-autonomous-delivery-robots-classifies-them-as-pedestrians/Content?oid=18482040>

## Section 2: Trends of the Next Two Decades

### Summary

Several independent trends suggest that the role of the automobile could decline in many urban areas in the United States over the coming 20 years, while use of transit and micromobility (two- or three- wheeled vehicles generally under 30 mph) is poised to grow in relative terms.

Most American cities added population during the 2010s, and that trend is likely to continue even if the option of remote work entices some people to move to more suburban locations. Growing density – including from conversion of urban office buildings to residential—will increase the share of trips that are within five miles, a distance that can often be traversed by modes other than driving.

Meanwhile, cities are adjusting street regulations to make walking, cycling, and scooting safer – often by slowing automobiles or restricting their movement. The growing urgency of climate change brings new attention to policies like vehicle-miles traveled taxes and congestion pricing that disincentivize driving (and raise funds for alternative modes).

Of course, the automobile will not disappear from the United States – nor from its cities. But cars are evolving rapidly. Anticipating tightening environmental restrictions, automakers are embracing electrification of their models. They are also investing heavily in autonomous technologies, though many knowledgeable observers doubt that AVs will be widespread in American cities within 20 years due the complexity of urban environments.

Finally, an ongoing surge in online shopping will worsen street congestion and risks creating curbside chaos. The next two decades could be as transformative for urban parcel delivery technology as the previous two were for passenger transportation.

This section examines these trends more closely.

### Urban Density

The last decade was a period of remarkable urban growth in the United States. While relatively new cities in the South and Southwest continued their rapid expansions, older ones like Chicago and Philadelphia reversed decades of steady population loss. Even many places that continued to see an overall decline, such as Detroit and Cleveland, saw a resurgence in construction and economic activity downtown. Meanwhile, mixed-use suburban neighborhoods grew in popularity, creating “nodes” of density throughout metropolitan regions. Residents of such communities could meet much of their daily transportation needs by walking or using micromobility.

Such shifts are significant for urban mobility. Transit works better in denser environments, and residents in such communities will have a higher share of trips that are under five miles, a distance that can often be covered by modes other than driving. Before Covid over half of all trips were already under five miles, presenting a prime target for mode shift.<sup>11</sup>

Other signs suggest that density could increase even in places where residents have been uneasy about it. Economically robust cities like Boston and San Francisco would almost certainly have larger populations now if they had approved taller building construction. Existing homeowners often oppose such developments, which can limit the increase in property value of their homes while leading to unwelcome competition for car parking.

Responding to a worsening housing crisis, the state of California recently intervened to force cities to allow taller buildings in certain strategic locations, such as plots adjacent to transit hubs. Other states – especially on the coasts—may follow California’s lead, overriding local opposition to denser construction. If they do, the resulting dense developments will further expand the market for driving alternatives.

### **Covid as an Urban Accelerant**

Author and New York University professor Scott Galloway has suggested that the coronavirus pandemic has been an accelerant of shifts that were already underway, including the move to remote working and an increase in online shopping. Those two trends alone are likely to have a profound impact on urban transportation and technology in the years ahead.

The transition toward remote working seems to have staying power, with a handful of tech companies and startups promising to let workers work from home indefinitely, and many others expressing openness to blended arrangements with more flexibility.<sup>12</sup> This shift away from the office could produce a number of countervailing effects on urban development, both diminishing and adding to the demand for new transportation technologies.

On one hand, the ability to work at home at least part-time could induce some people to relocate to more suburban or exurban locations, where modes other than driving are less useful. Such people may subsequently show interest in autonomous driving technologies, but less in modes better suited for density, like transit and micromobility. On the other hand, those stuck at home during the weekdays may place a premium on mixed use, multimodal neighborhoods that offer an opportunity to exercise or walk to a coffee shop or restaurant. If that happens, demand could grow for dense environments well-suited for non-car options, even in nodes far from the city center. Either of these scenarios would lead in a relative decline in peak-hour transportation

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<sup>11</sup> Office of Energy Efficiency and Renewable Energy. *In 2017 Nearly 60% of All Vehicle Trips Were Less than Six Miles*  
<https://www.energy.gov/eere/vehicles/articles/fotw-1042-august-13-2018-2017-nearly-60-all-vehicle-trips-were-less-six-miles>

<sup>12</sup> Schneider, Mike. *Major Startups and Tech Companies Take Pledge to Let Employees ‘Work Remotely Forever’, Launch Microsite*.  
<https://www.businesswire.com/news/home/20210624005705/en/Major-Startups-and-Tech-Companies-Take-Pledge-to-Let-Employees-%E2%80%98Work-Remotely-Forever%E2%80%99-Launch-Microsite>

demand into the city center – reducing the need for highway lanes and transit fleets designed to accommodate the “peak of the peak.”

Meanwhile, an emerging consensus suggests that urban real estate will shift away from office buildings and toward residential construction (especially in areas like Washington, D.C. and Seattle that have robust housing demand and many white-collar workers able to work remotely). A relative increase in urban residential construction could, again, spur greater demand for multimodal options such as scooters and cargo bikes, since a higher share of trips – to the store, to school, or to work– will be of relatively short distances.

For cities, another critical story of the pandemic has been the surge in online shopping. In 2020 alone online sales rose by almost a third.<sup>13</sup> Online shopping had already been growing for years, and retailers expect the trend to continue. Amazon, for instance, has placed an order for 100,000 delivery vans from Rivian.<sup>14</sup> Higher volumes of parcel delivery could strain urban infrastructure, adding to street congestion and creating potential safety hazards at overwhelmed curbs. Meanwhile, a bevy of new startups are offering delivery of goods within 15 minutes within urban areas, applying further pressure on public right of way (including on sidewalks, where some delivery drones operate).

The surge in deliveries could force cities and companies alike to innovate. Local officials, for their part, may embrace technological solutions for curbside management, and they could impose taxes and restrictions on just-in-time deliveries. Alternatively, they could create incentives for shippers like Amazon to group multiple deliveries to a household into a single trip. Companies, meanwhile, could move toward modes like e-cargo bikes that create less street congestion and are easier to park, or they may shift toward sidewalk drones.

## **Policy Trends**

As Section 1 illustrates, government policies and investments powerfully influence how people and goods travel. To pick just one example, the rise of the urban automobile would have been impossible if the public officials had not cleared pedestrians and children from streets by criminalizing “jaywalking” and by making immense investments in traffic enforcement and street expansion.

Government policy is poised to play an equally influential role in shaping the evolution of urban transportation technologies during the next 20 years. A few especially consequential policy trends are summarized below.

### *Climate change*

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<sup>13</sup> Palmer, Annie. *Groceries and Sporting Goods Were Big Gainers in the Covid E-Commerce Boom of 2020*. <https://www.cnbc.com/2021/02/19/e-commerce-surged-during-covid-groceries-sporting-goods-top-gainers-.html>

<sup>14</sup> Shama, Elijah. *Amazon is Purchasing 100,000 Rivian Electric Vans, the Largest Order of EV Delivery Vehicles Ever*. <https://www.cnbc.com/2019/09/19/amazon-is-purchasing-100000-rivian-electric-vans.html>

America's left-of-center cities have long acknowledged the urgency of climate change. Mayors of Austin, Houston, Los Angeles, and Phoenix are among those who have issued net-zero pledges.<sup>15</sup> Surveys indicate that American public opinion is shifting in their direction, suggesting that states and the federal government could enact new policies to reduce emissions, of which transportation is the largest source in the United States (Figure 1).<sup>16</sup>

Climate-friendly policies, such as federal incentives for electric vehicles, are already encouraging carmakers to embrace electric powertrains. Enactment of low-emissions zones – already adopted in over 200 European cities including London and Lisbon—could further catalyze the trend toward electrification.<sup>17</sup> For cities, this shift raises questions of where and how vehicles will be charged – especially if parked on the street. Already, photos on social media show electric cords draped over bike lanes or across sidewalks, creating hazards for vulnerable road users. Moreover, the added weight of electric vehicles' batteries makes them more dangerous to vulnerable road users (for example, the new Hummer EV weighs over 9,000 lbs).<sup>18</sup>

Many government officials seek to promote mode shift as well as electrification. According to the OECD, e-bikes, e-scooters, and transit all have a far lower carbon footprint than even electric automobiles.<sup>19</sup> Expansions of transit service can encourage people to ride the bus or train, while establishment of bus rapid transit lanes can make trip times more competitive with driving. Riding a bike or scooter could be promoted through the “carrots” of new protected lanes, employer benefits, or by tax credits for new purchases (as Congress has proposed for e-bikes in the Build Back Better Act). Or it could be encouraged through the “stick” of increasing the cost of driving and parking a car (which would also nudge drivers to consider public transportation).

Two nascent policies hold particular promise for instigating mode shift in the coming decades. One is a tax on vehicle-miles traveled (VMT), which could replace the gas tax in an era of increasingly electrified transportation. A VMT tax would naturally make all alternatives to driving relatively cheaper, and therefore more competitive. Meanwhile the deployment of congestion pricing in Manhattan south of 60<sup>th</sup> Street would make New York City the first American city to

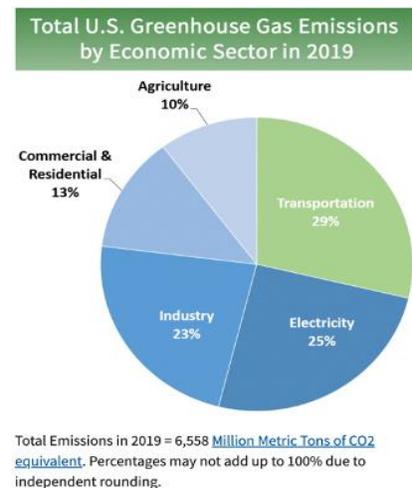


Figure 1. Source EPA

<sup>15</sup> C40 Cities. <https://www.c40.org/cities/>

<sup>16</sup> Winters, Joseph. *New Poll on Climate Change: Denial is Out, Alarm Is In*. <https://grist.org/climate/new-polling-on-climate-change-denial-is-out-alarm-is-in/>

<sup>17</sup> Vela, Alberto. *Low Emission Zones, a European Success Story*. <https://ecf.com/news-and-events/news/low-emission-zones-european-success-story>

<sup>18</sup> Ruffo, Gustavo Henrique. *GMC Hummer EV's Weight and Quickness Raise Safety Concerns*. <https://insideevs.com/news/510334/gmc-hummer-ev-weight-acceleration/>

<sup>19</sup> International Transport Forum. *Good to Go? Assessing the Environmental Performance of New Mobility*. <https://www.itf-oecd.org/good-to-go-environmental-performance-new-mobility#>

follow in the footsteps of global cities including London, Singapore, and Stockholm. Revenue from the New York City program is slated for upgrades to public transportation, helping to spur further mode shift away from driving. Other cities, including Los Angeles and Portland, have shown interest in congestion pricing as well.

Even if policymakers adopt aggressive steps to curb climate change, it is likely that disruptive events – floods, hurricanes, wildfires, and pandemics among them – will grow more frequent in the future. From a safety perspective, the Covid pandemic has shown that lockdowns lead to empty streets that can invite a surge in reckless driving. 2020 saw a growth in traffic fatalities even as VMT declined. “You swing to an entirely new crash type when people are under lockdown,” says Los Angeles DOT Director Seleta Reynolds. Meanwhile, sudden evacuations raise their own safety challenges, including the availability of rapid EV charging.

### *Safety for vulnerable road users*

An ominous traffic safety trend has emerged over the last thirty years: While people inside of motor vehicles are growing safer, those outside of them – so-called vulnerable road users (VRUs)—are at greater risk. Deaths among automobile occupants fell 14 percent from 2000 to 2019, while pedestrian fatalities grew 25% from 2000 to 2019 before jumping an additional 21% in 2020 alone.<sup>20 21</sup>

The causes of this divergence are controversial, but many experts place partial responsibility on an increase in distracted driving (likely attributable to smartphones and increasingly complex infotainment systems) and a shift toward heavy, tall SUVs and trucks that are more dangerous to VRUs in a collision. Urban policymakers have grown increasingly concerned about risks posed to VRUs, declaring their commitment to Vision Zero goals and adopting policies like “20 is Plenty” speed limits to mitigate risk. But there is a concern that such public proclamations offer an excuse to avoid more powerful but politically challenging moves to boost safety, like adopting road diets or building bike lanes.

Looking to the future, the federal government is overdue to revise the New Car Assessment Program (famous for its crash-test dummies) to reward automakers whose designs and technologies pose less risk to VRUs (i.e., sensors that detect a person in front of the car and automatically apply the brakes). NCAP programs in Europe, Japan, and Australia already incorporate VRUs into their ratings, but the United States has been a laggard. Revisions to NCAP could finally provide an incentive for automakers to slow the ongoing shift toward bigger, heavier SUVs and trucks.

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<sup>20</sup> National Safety Council. *Injury Facts*. <https://injuryfacts.nsc.org/motor-vehicle/historical-fatality-trends/deaths-by-type-of-incident/>

<sup>21</sup> Edwards, Erika. ‘Mind-boggling’: Pedestrian Deaths Surged in 2020, Despite Fewer Cars on the Road. <https://www.nbcnews.com/health/health-news/mind-boggling-pedestrian-deaths-surged-2020-despite-fewer-cars-road-n1267910> and National Safety Council. *Injury Facts*. <https://injuryfacts.nsc.org/motor-vehicle/historical-fatality-trends/deaths-by-type-of-incident/>

Incorporating Advanced Driver Assistance Systems into the Federal Motor Vehicle Safety Standards could help as well, as would mandatory inclusion of ambient detection of alcohol in a driver's bloodstream. Mandatory high quality Driver Monitoring Systems could reduce misuse of ADAS systems like Tesla Autopilot, as well as dangerous distraction from increasingly complex onboard infotainment systems. As was mentioned in the previous section, automakers have historically standardized safety features only when pressed by regulators. Notably, passive alcohol detection systems and NCAP updates were incorporated into the infrastructure bill passed by Congress in fall 2021.

States, too, could help protect VRUs by restricting aftermarket automobile products like bull bars and lift kits that create risk for those outside the vehicle without providing any compensating benefits for its occupants.

### *Curbside management*

As mentioned earlier, rapid growth in parcel delivery puts pressure on urban curbsides and invites new regulations. Cities may be motivated by a goal of raising revenue (for example, by renting 15-minute access to loading zones) and/or by a desire to reduce conflicts and double-parking that create safety risks, especially for pedestrians whose vision is obstructed and for cyclists forced into a general traffic lane.

Cities are already starting to turn to technology as a means of managing their curbs, most notably with the new data standards developed by the Open Mobility Foundation (manager of the Mobility Data Specifications). For many cities, a necessary first step is to create a digital map of curbs, along with all municipal parking regulations.

A "loser" in these curb reconsiderations is on-street parking. A growing number of city leaders are realizing that it makes little sense to provide scarce and valuable street space at a discount for private core storage. For that reason dense cities may increase the cost of on-street parking, including adding variable charges that adjust to demand. Some may remove parking entirely from certain blocks, concluding that the space is better allocated toward bike lanes, expanded sidewalks, or dining areas.

### **Business and Technology Trends**

Investments by transportation companies are heavily influenced by government policies, both announced and expected. Automakers, for example, are spending billions of dollars on electric vehicle technologies, anticipating tighter regulations. Uber and Lyft have issued public commitments to provide zero-emission transportation services, perhaps because they share venture capital investor Reilly Brennan's belief that ride hail will be unable to operate in major

cities in 2030 if vehicles are not emission-free (however, even electric ride hail vehicles create substantial environmental footprints due to deadheading).<sup>22</sup>

With so much investment directed toward electrification and batteries, improvements in efficiency and performance seem likely. The result will be higher-quality electric vehicles at a lower price point, which will hasten the shift away from ICE vehicles. That said, ICE vehicles will be with us for many decades yet, since the average car on the road today is 12 years old (and rising).<sup>23</sup>

The aging of automobile fleets is also an important trend for ADAS, suggesting that today's "smart" cars will be interacting with "dumb" ones on streets and highways for decades to come. Nevertheless, carmakers are expecting ADAS to become standard features on new vehicles due to consumer demand as well as potential updates to the Federal Motor Vehicle Safety Standards.

While ongoing ADAS development seems assured, the emergence of fully autonomous vehicles is not. No one interviewed for this report anticipates Level 5 autonomous vehicles being available within 20 years, and only a minority expect Level 4, which could be used only a given urban area. Level 4 is more technically feasible, but it likely requires substantial investment to ensure that infrastructure can "talk" to vehicles on the selected routes. There are no clear estimates of the total cost required to deploy Level 4 technologies across urban areas, but it would be substantial (initial projects, like the Michigan Connected Corridor, focus on intercity routes, rather than intracity<sup>24</sup>). The potential funding sources for such investments remains unclear.

Some cities may restrict the presence of any kind of automobile, autonomous or otherwise, limiting sections of downtown to public transit and micromobility, as European cities like Glasgow and Ljubljana have done. It is possible that dedicated routes in urban areas would be set aside for autonomous vehicles, but even that would likely prove contentious, with human drivers arguing they deserve access as well, and non-drivers wanting to "reclaim" street space from automobiles entirely.

Micromobility companies, too, will invest in new technologies in the years ahead. Shared e-scooter companies are developing automatic warning systems that can halt a user who is on a sidewalk or otherwise riding dangerously. Bicycle companies are shifting toward relatively profitable e-bikes, anticipating increasing demand encouraged by cities' investments in protected bike lanes. Notably, the declining cost of a high-quality e-bike or e-scooter could induce people to buy their own, instead of using shared vehicles. That will be good news for the pedestrians and wheelchair users concerned about vehicles strewn across sidewalks. As prices of micromobility

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<sup>22</sup> International Transport Forum. *Road Safety Annual Report 2020*. <https://www.itf-oecd.org/road-safety-annual-report-2020>

<sup>23</sup> Beresford, Colin and Miller Caleb. *Average Age of Vehicles on the Road Rises Above 12 Years*. <https://www.caranddriver.com/news/a33457915/average-age-vehicles-on-road-12-years/>

<sup>24</sup> Shieber, Jonathan. *Starting with Michigan, Sidewalk Infrastructure is Looking to Build Roads Specifically for Autonomous Cars*. <https://techcrunch.com/2020/08/13/starting-with-michigan-sidewalk-infrastructure-is-looking-to-build-roads-specifically-for-autonomous-cars/>

devices drop, the Jevons paradox suggests that people will find new ways to use them, all else being equal.<sup>25</sup>

Although private sector interests are investing heavily in V2X safety technologies, few city or government leaders interviewed for this report seem to put much faith in them. Most were more interested in enhancing safety through improved street design, such as building better bicycle lane protections and making pedestrians more visible to drivers at intersections.

Finally, the surge in online shopping has prompted a deluge of investments in urban delivery, most notably with sidewalk drones from companies like Starship and Kiwibot. Although such ventures have attracted significant venture capital funding, their future prospects remain questionable, with opposition likely from city officials concerned about access for pedestrians and people with disabilities. Already, FedEx and Amazon are turning to state officials in places like Pennsylvania to block cities from regulating sidewalk drones.<sup>26</sup> Another possible AV deployment scenario would involve using driverless vehicles to transport goods from warehouses to hubs located in exurban or suburban locations, from which those deliveries would be distributed to their final, urban destinations via micromobility or a manned automobile. Notably, cargo won't get annoyed when an autonomous vehicle obeys the speed limit – but passengers can.

## **Lessons for Safety**

Policy, demographic, and technological trends will largely determine the deployment of urban transportation technologies in the coming decades. Here are a few takeaway lessons for safety:

### *Urban density will catalyze transportation technology innovation and deployment*

It is too soon to know what long-term effects Covid-19 will have on urban development, but an increase in population density seems likely. Already, city office buildings are being converted to residential use as urban real estate prices have rebounded (bringing renewed concerns about gentrification).

All else being equal, greater urban residential density will generate more short journeys, because more destinations are proximate to a given location. These shorter trips can more easily be taken by a bike, scooter, sidewalk drone, or another emerging mode of transport, creating a tailwind for micromobility (and an incentive to develop innovative form factors, which will be discussed in the next section).

### *Climate change will fundamentally alter urban transportation*

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<sup>25</sup> Owen, David. *The Conundrum*. Riverhead Books, 2012.

<sup>26</sup> Deto, Ryan. *Pennsylvania Legalizes Autonomous Delivery Robots, Classifies Them as Pedestrians*. <https://www.pghcitypaper.com/pittsburgh/pennsylvania-legalizes-autonomous-delivery-robots-classifies-them-as-pedestrians/Content?oid=18482040>

Since transportation is the greatest source of emissions in the United States (and even electric cars have greater environmental footprints than biking, walking, and transit), environmentally-conscious cities will increasingly seek to reduce driving. More bike lanes can be expected (Paris's plan for 112 miles of new protected bike lanes in the next five years—about as much as in all of New York City—shows what is possible), as well as secure parking for micromobility vehicles. As a stick, cities could adopt congestion pricing and remove subsidies for on-street parking.<sup>27</sup>

### *Parcel delivery is poised for disruption*

The pandemic has accelerated the shift toward online shopping, bringing with it a rapid uptick in urban parcel delivery. With limited loading zones and curbsides, dense city neighborhoods are ill-equipped to handle the surge in deliveries, most of which are now transported on vans that create congestion and pollution as well as safety hazards when parked illegally.

Cities are likely to search for new ways to manage their curbs (and potentially make money in the process). Sensors and cameras could allow them to monitor parking spaces and collect fees from companies seeking access for package delivery or ride hail passenger pickup. They could also invest in wider bike lanes that can accommodate cargo bikes replacing delivery vans.

The private sector is already investing in new models of cargo bikes, which have become widespread in many Northern European cities. Another nascent delivery technology is the sidewalk delivery drone, which could negate the need for car trips to deliver or pick up a parcel. However, such drones require either roadway or sidewalk space, causing potential conflicts with other street users.

Regulatory friction seems inevitable, and the safe access to sidewalks among pedestrians, those in wheelchairs, and the visually impaired could be threatened in the coming two decades. Safety advocates may wish to consider a public campaign defending vulnerable sidewalk users' right to access footpaths free of obstruction from new technologies.

### *Widespread Advanced Driver Assistance Systems should be expected- but not autonomous vehicles*

While many private sector experts doubt that Level 4 or 5 automobiles will be available within cities by 2040, Advanced Driving Assistance Systems will continue to develop. Certain elements, like pedestrian detection and automatic emergency braking, offer potential to save urban lives, especially if the federal government requires them. Mandatory installation of passive alcohol

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<sup>27</sup> O'Sullivan, Feargus. *Inside the New Plan to Make Paris '100% Cyclable'* <https://www.bloomberg.com/news/articles/2021-10-22/how-paris-will-become-100-cyclable>

detection systems, included in the infrastructure bill of fall 2021, could also help reduce traffic fatalities.

*Cities are poised to further restrict automobile use – unless they are blocked by preemption*

In order to slow climate change, boost street safety, and improve urban quality of life, a growing number of city leaders and residents are embracing policies that disincentivize driving, such as reduced speed limits and the conversion of car lanes to other uses such as bus rapid transit and protected bike lanes. This push will continue, unless suburban and statewide interests intervene to halt it (which is certainly possible, especially in more conservative states).

The result may be dramatically different urban policy regimes around transportation between cities in “blue” states like New York and San Francisco compared with those in “red” states, like Dallas and St. Louis – even if city residents themselves by and large prefer similar policies.

Safety advocates should encourage states to allow cities to set their own standards for new mobility technology.

## Section 3: Form Factor Evolution

### Summary

A variety of new form factors for urban travelers have emerged over the last twenty years, including autonomous shuttles, bikeshare, e-bikes, e-scooters, and even the occasional electrified unicycle or skateboard. While it seems unlikely that urban passenger form factors will undergo an equally dramatic a transformation in the coming two decades, existing models are poised to evolve considerably – especially if they are boosted by investment funding and supportive government policies.

Propelled by the ongoing surge in online shopping, parcel delivery may be the nexus of urban technology evolution in the coming years. Sidewalk delivery drones, street delivery pods, and e-cargo bikes will compete to fulfill the growing demand for cargo’s “last mile,” a space that will grow more competitive as street curbs become congested.

While the automobile will remain a mainstay in American cities for many years to come, its access may be restricted from certain areas in dense urban environments (a trend that is already underway in Europe). For safety, the big question for automotive form factors is whether federal regulators will compel car companies to shrink the size of their new vehicle models, especially the large SUVs and trucks whose height and weight places vulnerable users in growing danger.

This section summarizes the potential evolution of urban transportation form factors in the next twenty years.

### Automobiles

For reasons outlined in Section 2, city residents and officials are growing more skeptical of the automobile, questioning its impact on urban pollution, quality of life, and street safety. Quite possibly, American cities will move to exclude the automobile from parts of the city center, as dozens of European cities already do, and as New York City did in 2019 with 14<sup>th</sup> Street in Manhattan. But the wide roadways and sprawled development of many American cities – especially in the South and West – ensure the ongoing presence of motor vehicles in most places.

Automobile purchases have been steadily shifting away from sedans and toward SUVs and trucks, to the point that sedans represent less than a third of new car sales.<sup>28</sup> Every purchase of a heavier, taller vehicle acts as an incentive for others to buy one too, so that the driver does not perceive herself to be at a disadvantage on the road. But large SUVs and trucks are especially dangerous to vulnerable road users outside the vehicle, a risk that most car buyers are unlikely to

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<sup>28</sup> Voelk, Tom. *Rise of S.U.V.s: Leaving Cars in their Dust, With No Signs of Slowing*.  
<https://www.nytimes.com/2020/05/21/business/suv-sales-best-sellers.html>

know (NHTSA's "stars for cars" New Car Assessment Program does not account for pedestrian and cyclist safety).<sup>29</sup> The risks to VRUs are especially acute within cities where pedestrians and cyclists concentrate. Electrification could worsen these safety concerns, with the new Hummer EV weighing over 9,000 pounds, thousands heavier than its ICE predecessors.

Since SUVs and trucks are more profitable to build and sell, it seems unlikely that automakers will shift their fleets toward smaller cars in the absence of an external force. Automobiles did shrink during the 1970s due to the oil crisis, but electrification is poised to untether auto size from the price of gasoline. The federal government, which maintains oversight of auto design through the Federal Motor Vehicle Safety Standards and the New Car Assessment Program, could force automakers to reconsider their trend toward larger size. The easiest option would be to incorporate VRU risk into NCAP crash safety ratings (something that many other global NCAP programs already do) or to put a weight and size limit on government fleet purchases, an approach that the Biden administration has used to catalyze the electric vehicle market.<sup>30</sup>

Taxis and ride hail, mainstays of urban transportation, generally align with contemporaneous auto design. If American car models continue adding weight and height, taxis probably will as well, creating disproportionate risk for VRUs given their heavy street use. However, many big cities maintain oversight of taxi permits (and a few oversee ride hail as well), giving them power to push for smaller vehicles, if they choose.

## **Public Transportation**

The rules of geometry dictate that public transportation will maintain a unique spatial advantage over other urban travel modes: its ability to move a lot of people within a confined space. For that reason, buses and trains are likely to remain essential transportation services for many years to come. Buses and trains are likely to electrify, and transit form factors may evolve as well, perhaps with articulated buses that require fewer drivers per passenger. But such changes will likely be incremental.

Still, emergent transit form factors do exist. One that attracts considerable attention is the microbus, often called "microtransit," and offered with on-demand availability. Passengers seem to like the on-demand aspect of these services, but their required per-passenger subsidies have been significantly higher than for fixed-route, full-sized buses. Unless those basic unit economics change, the scalability of microtransit is limited.

Several transit agencies have also experimented with autonomous shuttles, such as systems in St. Petersburg, Fla. and Las Vegas, Nev. While these shuttle services have attracted curious passengers, no agency has attempted to scale them to be a substantial transport mode, and no

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<sup>29</sup> Tyndall, Justin. *Pedestrian Deaths and Large Vehicles*.

<https://www.sciencedirect.com/science/article/abs/pii/S2212012221000241?via%3Dihub>

<sup>30</sup> Zipper, David. *The U.S. Could Make New Cars a Lot Less Deadly*. <https://www.bloomberg.com/news/articles/2021-01-06/u-s-new-car-safety-ratings-are-overdue-for-update>

one interviewed for this report expects autonomous shuttles to become a standard transit service within the next twenty years (advantages over manned shuttles are minimal, especially since a transit staff person would probably still be required to provide safety and customer service).

## **Micromobility**

While automobiles and transit vehicles are likely to look only marginally different in twenty years, micromobility could evolve at a much faster clip.

Rapidly improving lithium-ion batteries are changing what a two- or three-wheeled vehicle can do. American e-bikes sales grew by over 200% over the last year, and evidence from Europe indicates significant room for continued growth (e-bikes already represent 20% of bike sales in Denmark).<sup>31</sup> Notably, the addition of an electric battery could entice more Americans to treat the bicycle as a mode of transportation, rather than the recreation vehicles that pedal bikes have mostly been for American adults.

While the expansion of bike lanes and the decline of cheap urban parking will attract converts to e-bikes, variations on the form factor could grow into their own distinct market segments, targeting people with different needs and physical ability. E-cargo bikes, for instance, are especially appealing to urban families with young children and to small businesses delivering goods. Meanwhile e-trikes can provide enhanced access for those with limited mobility, such as the elderly or people with disabilities.

The future of e-scooters seems less clear. E-scooters are likely to grow heavier, with wider wheels that provide more durability and stability. But their relative value vis a vis e-bikes seems questionable, except for recreational purposes. Notably, most of the major shared e-scooter companies have expanded into e-bikes in recent years, pivoting toward growth opportunities in that form factor.

Importantly, the delineation between various micromobility terms – moped, motorcycle, e-bike, scooter—is becoming muddled. E-bike makers like VanMoof are already building vehicles that can go 60 km/hr, beyond the federal limit for an e-bike. States, too, are ill-equipped to manage such speedy two-wheelers, which often do not fit into existing regulatory categories.<sup>32</sup> Given the pace of technological evolution, Professor David King of Arizona State has suggested that regulators abandon any hope of grouping micromobility into set classifications – as SAE has tried to do – and instead set maximum parameters for the speed and weight of a vehicle that is permissible in a given lane of urban traffic. Such an approach would still require enforcement,

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<sup>31</sup> Bike Europe *E-Bike Market Share in Denmark Grows to 20%*. <https://www.bike-eu.com/41630/e-bike-market-share-in-denmark-grows-to-20> and Sorenson, Dirk. *The Cycling Market Pedals Ahead in 2021*. <https://www.npd.com/news/blog/2021/the-cycling-market-pedals-ahead-in-2021/>

<sup>32</sup> Zipper, David. *As E-Bikes Speed Up, a Policy Dilemma Looms*. <https://www.bloomberg.com/news/articles/2021-10-29/super-fast-e-bikes-could-risk-a-regulatory-backlash>

perhaps emulating a tactic from Amsterdam, where automatic cameras now identify and ticket people who illegally ride mopeds in bike paths.<sup>33</sup>

A pivot toward regulating by weight, size, and speed (instead of vehicle types) could align well with the interests of the private sector. “You don’t want to limit the form factor evolution through excessive regulation,” says Dmitry Shevelenko, CEO of Tortoise, a micromobility startup. “Just regulate for speed and size, and give shared vehicles the same restrictions as owned vehicles.”

### **New Passenger Form Factors**

While form factor evolution is assured, it is also possible that entirely new modes of urban transportation will find a receptive audience in the coming years.

In particular, a reduction in on-street car parking (and an increase in the cost of parking that remains) could compel people to turn toward “quadricycles,” vehicles that are smaller and lighter than a traditional automobile. Such vehicles have already started to catch on in European cities. The Citroen Ami, a quadricycle that weighs under 1,000 lbs, has found an enthusiastic initial customer base in Paris, and Citroen has expressed a desire to bring the vehicle to the United States.<sup>34</sup> Quadricycles are easier to park than full-sized cars, and also less dangerous to pedestrians and cyclists in the event of a collision.

Other form factors could also fill a niche as a slower, smaller replacement for the automobile. Golf carts, already widespread in The Villages, Fla. and Peachtree City, Ga., offer a convenient way to navigate urban streets (or trails) at reduced speeds. If urban policies nudge people away from automobiles, golf carts could become more popular. And a new type of enclosed e-trikes from startups like Nimbus and Arcimoto is akin to enclosed motorcycles. Again, such vehicles could offer substantial safety benefits compared with automobiles due to their reduced physical footprint and lighter weight.

Although e-cargo bikes are not “new,” they could become a widespread mode of urban transport in the years ahead. Configured for small children, e-cargo bikes can provide greater mobility for families than a pedal bike – but they also strain bike lanes, which are sometimes too narrow to accommodate them comfortably (In Europe, 1.5-2 meters is the suggested bike lane width.).<sup>35</sup>

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<sup>33</sup> Mazzagatti, Francesco. *Over 600 Moped Drivers Caught on Amsterdam Cycle Lanes*. <https://euronewssource.com/over-600-moped-drivers-caught-on-amsterdam-cycle-lanes/>

<sup>34</sup> Henley, Jon. *Ami, the Tiny Cube on Wheels that French 14-Year-Olds Can Drive*. <https://www.theguardian.com/world/2020/sep/11/ami-the-tiny-cube-on-wheels-that-french-14-year-olds-can-drive>

<sup>35</sup> Zipper, David. *We Are Going to Need a Lot More Electric Delivery Bikes*. <https://www.bloomberg.com/news/articles/2021-09-01/how-to-pave-the-way-for-more-electric-delivery-bikes>

## Package Delivery

It is likely—even probable—that sustained growth in online shopping will force cities and shippers alike to find ways to reduce pressure on overwhelmed curbs (as well as congested neighborhood streets). While companies like Amazon are investing heavily in electric delivery vans, such vehicles cannot address the geometric challenge of fitting ever more vans into a limited amount of street and curb space. Form factor innovation is likely.

The cargo bike has already been discussed as an emergent urban vehicle. Importantly, the experience of European cities – where e-cargo bikes are far more widespread—suggests that the construction of bike lanes and subsidies for e-cargo bikes are not enough to spur a switch from delivery vans. To induce mode shift, governments must also restrict delivery vans’ access to congested urban areas during high-demand times. This step is politically challenging, but shippers seem to take little action without it. Case in point: Boston issued an RFI seeking private partners on an e-cargo bike exploration in 2019, but not a single major shipper responded (although several have conducted high-profile, tiny e-cargo bike pilots in cities like Portland and Miami).<sup>36</sup>

Beyond e-cargo bikes, shippers could turn to autonomous vehicles or drones to provide last-mile urban deliveries. One model consists of “delivery pods” from companies like Nuro, which operate on the street alongside automobiles. From a safety perspective, such vehicles offer the benefit of reducing the number of full-sized automobiles on urban streets, but with the downside of additional congestion at the curb. An alternative model is the sidewalk drone, provided by companies like Tortoise and Starship. Such vehicles do not contribute to street congestion, but they could create hazards for pedestrians and those with limited mobility (imagine a sidewalk drone blocking the curb cut that a wheelchair user needs to access). As noted in Section 2, states like Pennsylvania have preempted cities from regulating sidewalk drones up to 550 lbs, which could endanger pedestrians.

These emerging parcel delivery technologies are poised to pit the mobility interests of shippers against those of people relying on sidewalks and curbs to move around a given neighborhood. Tension seems inevitable.

## Scaling Conditions

While the evolution of particular urban form factors cannot be predicted with confidence, certain conditions will make their emergence more or less likely over the next twenty years.

The table and summary below offers a simplified assessment of the conditions that will catalyze or retard the adoption of new form factors discussed in this report. Note that the list is limited to

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<sup>36</sup> Zipper, David. *We Are Going to Need a Lot More Electric Delivery Bikes*. <https://www.bloomberg.com/news/articles/2021-09-01/how-to-pave-the-way-for-more-electric-delivery-bikes>

devices that “look different” from what is normal on American city streets in 2022. For that reason electrification and autonomous technologies are not included, since vehicles equipped with such features may resemble those that are already familiar.

Also, some emergent form factors will require significant density in order to scale, meaning that they are much more likely to find traction in a city like San Francisco or Chicago than a sprawled suburb or car-oriented city like Phoenix or Las Vegas. Density-reliant technologies are noted with an asterisk in the table below.

	Reduction in on-street parking (or increase in cost)	Growth in protected bike lanes	Growth in urban density	Increase in online shopping	Increase in active curbside management	Lower urban speed limits	Delivery van restrictions	Preemption by business-friendly state legislators	Federal incentives for less dangerous autos	Decongestion pricing	VMT taxation	Significant battery improvements	Federal subsidies for electric vehicles
Smaller cars													
*E-bikes													
*E-cargo bikes													
*Golf carts													
*E-trikes													
*Sidewalk drones													
Street delivery pods													

Key	
	Significant positive impact -- this condition could dramatically scale the form factor
	Moderate positive impact -- this condition would support the form factor's growth, but would not assure it
	Neutral -- no clear impact on scaling the form factor
	Moderate negative impact -- this condition would reduce the form factor's growth, but would not cripple it
	Significant positive impact -- this condition could dramatically cripple the form factor's emergence
*	Density-dependent -- form factor reliant upon a neighborhood achieving baseline density

*Smaller Cars* – Federal restrictions or disincentives regarding large trucks and SUVs could halt the “arms race” toward ever-larger vehicles, renewing interest in smaller sedans, which have fallen out of favor with consumers. But policies like VMT taxes and decongestion pricing could push urban residents away from all automobiles, regardless of size.

*E-bikes* – Rules or programs that restrict automobiles would elevate demand for e-bikes. Even more of a boost would follow the construction of new protected bike lanes. Restrictions on delivery vans and lower speed limits would also make biking safer, thereby lifting demand.

*E-cargo bikes* – Like e-bikes, e-cargo bikes become more desirable if automobiles face urban restrictions, and if cities build safe places to ride. In Europe, delivery van restrictions have powerfully catalyzed adoption.

*Golf carts* – Much like e-bikes, golf carts become more desirable when automobile use is restricted, and especially when speed limits drop. However, the size of golf carts makes them potentially vulnerable to restrictions in on-street parking and limits their ability to use bike lanes (though often not bike paths).

*E-trikes* – E-trikes are subject to the same positive and negative forces as e-bikes. In addition, preemptive state legislation could force cities to allow e-trikes on bike lanes where cities might otherwise prohibit them.

*Sidewalk drones* – Like e-cargo bikes, demand for sidewalk drones is likely to rise if automobiles and delivery vans are restricted in an urban area – and especially if online shopping continues to expand. Because such robots have a limited range, an increase in density will expand their potential market size. Although the drones could come into conflict with those who rely on sidewalk access, preemptive state laws could speed their adoption (and potentially guarantee them access to bike lanes).

*Street delivery pods* – As with sidewalk drones, growth of street delivery pods is tied to expansion of online shopping and restrictions on automobiles. State preemption could negate pushback from cities wary about their effects on congestion, especially at the curb.

## **Lessons for Safety**

The emergence and evolution of form factors could help resolve certain safety challenges on urban streets, while also creating new ones. Important points to consider are summarized below.

### *Urban package delivery is poised for transformative change*

In dense neighborhoods, growth of online shopping and parcel delivery will worsen congestion and place severe pressures on urban curbs. As described in Section 2, cities are already exploring strategies to bring order to curbside management. It is likely that private companies will develop and scale new modes for urban parcel delivery—though it remains to be seen which form factors will catch on.

E-cargo bikes could gain popularity, especially if cities build new protected bike lanes and restrict delivery vans. Such an outcome may offer the greatest potential to improve urban safety, since cycling is already a standard transport mode in many cities. Teleoperated or autonomous drones could also fill the niche of parcel delivery, though they risk creating new conflicts with pedestrians and cyclists.

Given the high likelihood that parcel delivery vehicles will encroach on sidewalk and curb access of urban residents, safety conflicts are likely – especially if cities are preempted from constraining the vehicles’ use. This should be a high-priority issue for safety advocates in the years ahead.

### *The federal government could incentivize smaller cars*

American automobiles have grown taller and heavier for decades, both because customers have swapped their sedans for hefty SUVs and trucks, and because SUVs and trucks have themselves

become larger. These trends have been deadly for vulnerable road users who become more likely to be killed or injured in the event of a collision.

The federal government is the primary actor that can force a reduction in vehicle size by encouraging consumers to choose smaller cars and/or forcing changes to automotive design. Revising NCAP to take into account safety of people outside the vehicle is an obvious move. FMVSS could also be adjusted to limit elements like weight or hood height, though the process would take years to implement. Safety advocates should be actively engaged on updates to both.

*Micromobility will blur the lines between existing form factors, creating conflict in new parts of the street*

At present, many state laws delineate between motorcycles, mopeds, e-bikes, and scooters. Those standards are growing outdated as manufacturers design faster e-bikes, heavier scooters, and new three-wheeled e-trikes that don't neatly fit into any existing category.

Beyond the regulatory confusion, these emergent form factors force questions about where users should ride them. In a general traffic lane, alongside cars that put the rider at risk? Or in a bike lane, where the rider will travel far faster than pedal cyclists? These will not be easy questions to resolve.

One solution could be to avoid classifying vehicles by type, and instead adopt rules specific to a given lane of urban street, with a maximum weight, speed, and size. Such an approach would have the safety benefit of grouping similar vehicles together, while also offering flexibility for companies and entrepreneurs to develop new form factors, confident in their legality on city streets.

## Section 4: Future Conflicts Among Street Users

The next twenty years of urban mobility technology could unfold in dramatically different ways. To appreciate how much is at stake, consider two extreme – but not implausible – accounts of cities and traffic safety in 2040. The first is idyllic; the second dystopian.

### Scenario 1: The Hope

*Today the United States celebrated its tenth consecutive year of traffic fatality reductions, led by a stunning 50%, decade-long drop in pedestrian and cyclist fatalities. Car crashes have declined too; autonomous vehicles have not become nearly as ubiquitous as boosters predicted a generation ago, but collision warning and avoidance technology, as well as mandatory driver monitoring systems, provide levels of protection that would have been unthinkable during the Biden presidency.*

*The federal government deserves considerable credit for the thousands of saved lives. After a popular backlash against autonomous vehicle technology – prompted by a spate of fatal crashes resulting from car technology that failed to work as expected – NHTSA adopted a more muscular approach toward regulating ADAS and autonomous systems. The New Car Assessment Program was revised to include ADAS performance standards, as was FMVSS a few years later. NHTSA was also instrumental in halting the decades-long growth in truck and SUV size by revising NCAP to evaluate design risk posed to people outside the vehicle.*

*Cars are not only less dangerous today; there are also a lot fewer of them in urban areas. Dense cities like Seattle and Boston have banned them outright from the downtown core, and decongestion pricing has added a cost to driving into urban neighborhoods in ten large metro areas (an expense that is additional to the national VMT tax, of course). During the 2030s, revenue collected from decongestion pricing funded the largest transit service expansion since the subway boom of the early 1900s, compelling many residents to trade their car for a transit pass (or a bike, since cities like Los Angeles have finally built a viable, citywide network of protected lanes). With fewer cars, on-street parking in many neighborhoods has been converted to streeteries or bike lanes, while off-street parking lots now host e-cargo bike delivery hubs (as well as a few trendy night clubs). On-street loading zones remain available– assuming you book your reservation online, paying the city for the privilege.*

*Still, there are plenty of cities where cars remain fixtures downtown, especially in the South and Southwest. But even there, traffic deaths have fallen due to safer car designs, better ADAS, and the Universal Sidewalk Act of 2025, which provided billions of federal dollars to help states expand sidewalk networks in urban and suburban neighborhoods (and especially in low-income communities). The Act also codified cities' right to control access to federally funded sidewalks, which blocked corporate lobbyists from trying to use state legislation to tie the hands of local officials.*

*Not everything in urban transportation is perfect, mind you. The ongoing growth in online shopping – and many cities’ bans on delivery vans – has led to a surge in cargo bike deliveries, annoying some city residents who dislike encountering the vehicles on bike paths or sidewalks. Cities have started building “slow lanes” designed for vehicles faster and bigger than a bike, but smaller than a car. Such networks remain in their infancy, though, and urban residents are still getting used to them.*

*Although the benefits to safety (and quality of life) of our urban evolution are obvious, some car owners wax nostalgic about the “good old days” when they could drive anywhere they liked – and often park for free! But most urban residents agree that the changes have been for the better. In addition to saving lives, the decline of the urban automobile led to an unexpected surge in people wanting to live in central cities, fueling an urban real estate boom (and bringing new money into city coffers). It also helped – finally – reduce total transportation emissions from the United States, an urgent need as climate change’s weather disruptions have only grown worse.*

*There is certainly more work to be done. But today, in 2040, we can confidently proclaim that safer, greener transportation has powered a nationwide urban renaissance.*

## **Scenario 2: The Fear**

*Today’s newly-released traffic fatality data confirmed officials’ fears: 2039 marked the tenth consecutive year with an increase in road deaths. For the first time, vulnerable road users – cyclists, pedestrians, and e-micromobility riders – reached 50% of all fatalities.*

*Most of those vulnerable road user fatalities occurred in urban areas, resulting from a collision with a motor vehicle. With trucks and SUVs weighing more and growing taller than ever, the force they exert in a crash with a pedestrian or cyclist (or a person in a sedan, rare though they are) can easily be deadly. Low-income Americans are particularly at risk, as they are forced to traverse hostile infrastructure like urban arterials on the way to jobs in retail, hospitality, and manufacturing.*

*Automakers continue to blame the rising number of fatalities on the mistakes of road users, and they met the bleak traffic fatality news with a promise to launch a new, multimillion dollar education campaign encouraging pedestrians and cyclists to obey traffic laws and avoid listening to headphones or checking their phone while walking. They also promised to double down their investment in driver monitoring systems, though those of course will remain optional (Congress and NHTSA have shown no inclination to mandate DMS after popular pushback in 2030 forced NHTSA to abandon its plans to require such systems on all new vehicles).*

*Disability groups expressed particular alarm at the rising death toll, as those with limited mobility have comprised a growing share of fatalities. The surge in online delivery bots has occasionally forced vision-impaired people and wheelchair users into the street itself, a dangerous situation that*

*seems to be happening more frequently (data is not reliable, as a federal effort to add specificity to the FARS database was squashed by lobbyists from automakers and delivery companies). City leaders have expressed concerns, but they are often powerless in the face of state law that requires delivery bots to be treated as pedestrians. State laws have also prevented many cities from restricting use of electric car chargers draped over sidewalks, which can trip pedestrians and block those who are mobility-impaired.*

*Cities have plenty of other transportation worries as well. A drop in federal funding for transit forced service reductions that led more people to drive, further contributing to a rising number of traffic fatalities. With more people behind the wheel, support for bike lanes (and cycling in general) fell dramatically from its modern peak during the Biden administration. Without safe places to ride, e-bikes, which seemed so promising a generation ago, failed to catch on (and good luck finding an e-cargo bike anywhere other than a flea market these days). Cities have converted many bike lanes to be dedicated autonomous vehicle lanes, with physical barriers restricting access to pedestrians and cyclists (AV-mounted cameras scan the faces of any trespassers, who will then receive a ticket in the mail).*

*Urban transportation networks become particularly strained when a forest fire, flood, or hurricane strikes a big city – which is happening more and more frequently. Electric cars take time to charge, and evacuating residents may not be able to wait. But the “need it in an emergency” mentality leads almost everyone in a city to buy a car if they can afford one – further straining parking lots and streets.*

*With so many risks and daily headaches, it’s not surprising that a growing share of Americans are fleeing cities for exurbs and rural areas where they can worry less about traffic or danger crossing the street. But as urban populations fall, it’s strange that highways and arterials remain as congested as ever. Perhaps we just haven’t built enough of them yet.*

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Will we end up in the utopia or dystopia scenarios– or somewhere in between? Federal policy will be determinative, as Congress and USDOT could fund infrastructure and set policies that fuels the growth of transit and micromobility and protects vulnerable road users – or they could maintain the laissez faire status quo, paving the way for ever-larger, taller cars and perpetuating autocentric street designs (potential policy solutions are described in Section 2).

From the lived experience of an urban resident or visitor, traversing a city will feel safer or more dangerous as a result of specific interactions that they have on sidewalks, streets, dedicated lanes, and parking lots with other people (and vehicles).

Each type of street space is explored below.

## General Use Traffic Lanes

It is possible – though by means assured – that cities will ban cars completely from traffic lanes in downtown districts. The experience of New York City’s 14th Street, car-free since October 2019, shows that such moves can lead to a sharp decline in fatalities.

That said, even the most aggressive forecasts for car-free streets assume that general traffic lanes will remain the norm across urban areas during the next twenty years (perhaps outside a few exceptionally dense areas like Manhattan and Chicago’s Loop).

From a safety perspective, a key question is whether general use traffic lanes will accommodate vehicles smaller and slower than motor vehicles, such as bicycles and scooters. Discrepancies in speed and weight create greater risk for collisions that cause injury or death. The surging popularity of micromobility indicates that these risks could grow. Building protected bike lanes, which create a physical barrier between cyclists and automobiles, or slow lanes (discussed below) would remove some of the more vulnerable road users from general traffic lanes. Slower automobile speeds can also help by reducing the force applied during a collision. Speed limits, automatic traffic enforcement (with speed cameras), and traffic calming are all viable ways to reduce cars’ speed within urban areas. Crucially, they offer protection from 20-year old cars lacking any ADAS technology as well as new vehicles equipped with state-of-the-art features.

In the future more automobiles will be equipped with ADAS technologies like automatic emergency braking and pedestrian detection. When combined with lower car speeds, these technologies are more effective at reducing crashes (AEB can do little to mitigate a collision if the vehicle is traveling at 45 mph, but a lot at 25 mph). Wider deployments of ADAS across American passenger vehicles suggest that parking lots, in particular, could grow safer in the years ahead.

Level 2 systems like Tesla Full-Self Driving are far from ready for broad, safe deployment in complex urban environments, and the experts consulted for this report agreed that Level 5 driving in cities is unlikely to become common during the next twenty years. However, Level 4 deployments in cities could be possible – if local officials are willing to simplify the urban environment by forcefully restricting “unpredictable” street elements like pedestrians and cyclists (the history of jaywalking suggests such moves are very dangerous for urban life).

However ADAS and autonomous technologies unfold, automotive tech alone have a limited ability to enhance safety. With the average car on the road over 12 years old, plenty of cars on the road will be “dumb” for many years to come.<sup>37</sup> For that reason, protective infrastructure like bulb outs and leading pedestrian indicators, as well as speed enforcement, will remain essential to protect

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<sup>37</sup> Beresford, Colin and Miller, Caleb. *Average Age of Vehicles on the Road Rises Above 12 Years*. <https://www.caranddriver.com/news/a33457915/average-age-vehicles-on-road-12-years/>

vulnerable road users (and encourage the use of transit, an especially safe mode of transit apart from the “first mile” and “last mile” that requires a passenger to walk to and from a station).

It should also be emphasized that the fatality risk of a collision rises in proportion with vehicle mass, a worrisome fact as cars and trucks grow ever-larger and add hefty batteries. Will NHTSA intervene to push automakers to reverse the expansions in car size and weight? It remains to be seen.

## **Sidewalks**

With the ongoing surge in urban delivery, sidewalk delivery drones could become far more numerous in the years ahead. The emergence of drones – as well as the continued growth of micromobility – will add to existing demands for sidewalk space. But the “supply” of sidewalks is unlikely to grow without an influx of federal funds. That would require breaking the American norm of leaving sidewalk management to local governments and abutting property owners, despite their limited resources.

Pedestrians – especially those pushing strollers, using wheelchairs, or visually impaired – are at greater risk as sidewalk crowding grows. As mentioned in Section 1, some states have already forced cities to treat sidewalk drones weighing hundreds of pounds as though they are pedestrians. With cities’ hands tied, people needing access to curb cuts or narrow footpaths could find their progress blocked.

Technology alone cannot fix these problems. As a general approach, cities could reduce sidewalk conflicts by encouraging non-pedestrian activities to occur on the roadway itself, by taking steps such as building protected bike lanes (so that micromobility users aren’t forced to use the sidewalk) and by replacing on-street car parking with micromobility corrals (so that vehicles are not abandoned on footpaths).

In cities with significant on-street parking, the ongoing electrification of automobiles may bring further challenges for sidewalk users. Electric cords draped over sidewalks to reach an EV on the curb could trip pedestrians and/or block those using a wheelchair or stroller. Although cities like New York are racing to adopt on-street electric charging facilities, their societal value remains dubious (scarce urban curb space has many other uses beyond providing a place for private car owners to charge their vehicle).

## **Curbs**

As discussed in previous chapters, anticipated increases in both urban density and package delivery –along with a decline in on-street parking – will bring new demands for curb space in high-traffic areas such as downtowns and shopping districts. Micromobility users, cargo bike delivery drivers, and parcel delivery drones will want a piece of the curb, in addition to ride hail,

delivery vans, automobile drivers, and restaurants seeking to expand outdoor dining. As mentioned above, owners of electric vehicles may also seek to charge their vehicles at the curb.

Congested curbs can lead to double-parking, which endangers micromobility users and pedestrians by shrinking their sight lines and forcing them to use general traffic lanes. A number of solutions to curbside conflicts are available. Cities could restrict delivery vans from center city areas (as many European cities have already done) and/or lease high-demand curb space in 15- or 30-minute increments. Charging for loading zone access could bring new revenue into public coffers, but it requires cities to first develop an updated digital map of curbs and associated parking regulations – something many currently lack.

If cities are willing to use pricing as a way to control curb access, startups like Automotus, Coord, and curbFLOW can provide products that allow on-street parking to be rented in short increments, with the startup and city splitting revenue collected. Recent pilots have been conducted in cities including Omaha, Neb., Aspen, Co., and West Palm Beach, Fla. Large cities, like Philadelphia, have begun to show interest as well.

## **Bike Lanes**

As mentioned in earlier sections, during the pandemic many American cities stepped up construction of both unprotected bike lanes and protected “cycletracks.” The enhanced safety of cycletracks can especially encourage new people to start riding (in lieu of a car, potentially).

If bike lanes become more heavily used, conflicts within them could grow. E-cargo bikes, still in the initial stages of adoption, can spill over a bike lane’s border, creating a safety hazard for those traveling in the opposite direction and making it difficult for another cyclist to pass. Wider bike lanes could help mitigate such risks, while also accommodating e-trikes and other e-bikes used by those with limited mobility.

High-speed e-bikes pose their own challenges in a bike lane. With new models like the VanMoof V exceeding 25 mph, those riding at slower speeds or with children may feel (and be) unsafe sharing a lane with a much faster vehicle. For that reason cities may start exploring ways to restrict the speeds of vehicles within bike lanes. Enforcement will be a challenge, and it could lead cities to consider adopting bike lane speed cameras. Another approach involves geofencing that can restrict the speed of e-bikes within urban areas, a technique that VanMoof itself has supported.

Although these tensions around bike lanes are important, they pale in comparison to the danger that a far heavier and faster automobile presents to a cyclist in a city. Cars and trucks will remain the greatest risk to street safety in the future.

## **Other Dedicated Lanes**

In recent years cities like Richmond, Va. and Las Vegas, Nev. have added their first bus rapid transit lanes (BRT), with access restricted to buses (cyclists are sometimes allowed as well). Cities seeking to make the bus more competitive with automobiles often see BRT as an attractive strategy to reward commuters who consume less street space (because bus riders typically have lower incomes than car drivers, BRT brings equity benefits as well). Technology products from companies like Siemens and Hayden AI can help cities keep bus lanes free of automobiles by issuing automatic tickets to violators. All else being equal, a relative shift in urban trips from automobiles toward transit will save lives, assuming that riders have safe ways to access the transit stops.

Looking to the future, it is possible – though not necessarily likely – that cities will establish dedicated lanes for autonomous shuttles used by transit agencies. Autonomous shuttles can operate more easily without the need to interact with driven cars, cyclists, and pedestrians. But pushback from such a move could be intense from good-governance advocates questioning why an AV shuttle should get preference over a relatively more efficient, manually-driven bus as well as from car drivers who resent the access restriction. Dedicated AV lanes may be more feasible on highways outside of urban areas, leveraging technology provided by companies like Cavnue.

A final kind of dedicated lane could be a “slow lane,” something between a bike lane and a general traffic lane. Designated for vehicles too fast or heavy for the former but too slow or light for the latter, slow lanes could suit emerging form factors like e-trikes, super-fast e-bikes, and street delivery drones. These lanes would require protection from general traffic lane vehicles, and they would be wider than typical bike lanes. They would also necessitate a new regulatory regime based on weight and size. No American city has adopted such infrastructure yet, but as form factors continue evolving, interest could grow.

## **Parking**

Less studied than other forms of urban transportation infrastructure, parking garages and surface parking lots could undergo tremendous change in the years ahead, especially if decongestion pricing and car restrictions limit parking demand. In Europe, parking garages in cities like Prague and Dublin have been repurposed as e-commerce distribution hubs, a trend that could come across the Atlantic.

On-street parking, too, will come under greater pressure, particularly as cities question longstanding subsidies to car owners parking their private property on public space. European cities like Amsterdam and Paris have removed tens of thousands of parking spots steadily but gradually, giving residents a chance to adapt. Such a move in the United States seems possible, as do increases in the cost of residential parking permits (which remain free in cities like Boston,

and unnecessary in the outer boroughs of New York City). Although it grabs few headlines, the evolution of urban parking could quickly transform Americans' modal choices.

## Appendix 1: Selected References

*NOTE: These references may not be available online. Individual sections contain footnotes with weblinks.*

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## Appendix 2: Interviews Conducted

Name	Title	Organization
<b>Academia</b>		
David King	Professor	Arizona State
Peter Norton	Professor of history	University of Virginia
Missy Cummings	Professor of engineering	Duke University
Phillip Koopman	Professor of engineering	Carnegie Mellon
<b>Advocacy</b>		
Bill Nesper and Ken McLeod	Executive Director and Director of Policy	League of American Bicyclists
Anna Zivarts	Director	Disability Mobility Initiative Program
Alisyn Malek	Executive Director	Commission for the Future of Mobility
Multiple executives		AARP
<b>Private Sector</b>		
Mark Rosekind	Chief Safety Officer	Zoox
Marla Westervelt	Former Bird, Eno, and LA Metro	
Shin-Pei Tsay	Head of Global Policy	Uber
Reilly Brennan	Partner	Trucks VS
Horace Dediu	Founder	Micromobility Industries
Dmitry Shevelenko	CEO	Tortoise
Jordan Davis	CEO	Smart Columbus
<b>Government</b>		
Robin Hutcheson	Deputy Assistant Secretary for Safety	U.S. Department of Transportation
Jascha Franklin-Hodge	Executive Director	Open Mobility Foundation
Joshua Schank	Director, Office of Extraordinary Innovation	Los Angeles Metro
Corinne Kisner	Executive Director	National Association of City Transportation Officials
Selete Reynolds	Director	Los Angeles Department of Transportation
John Perracchio	Former chair	Michigan Council on the Future of Mobility (and insurance expert)
Karina Ricks	Director	Pittsburgh Office of Mobility and Infrastructure