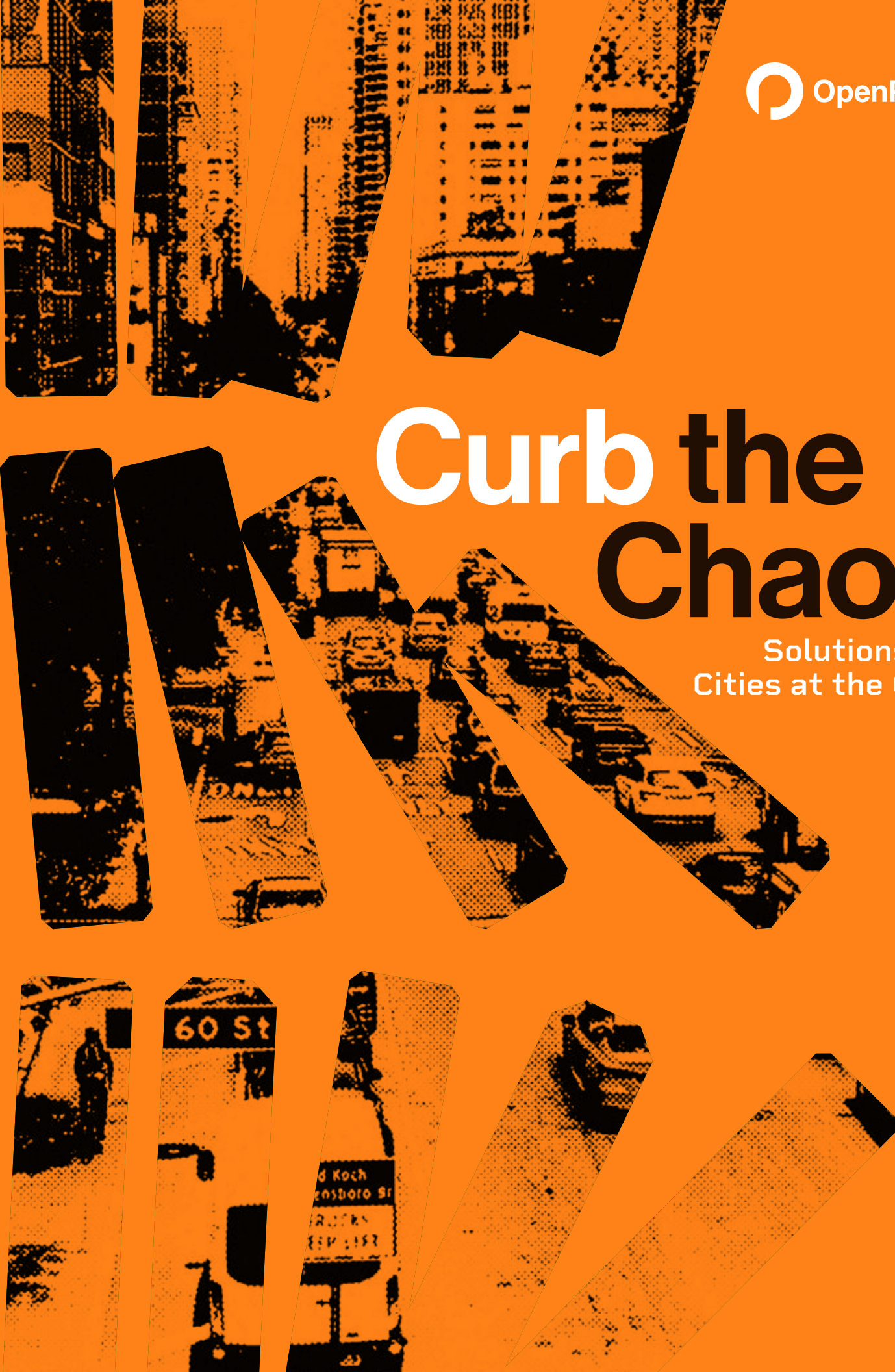
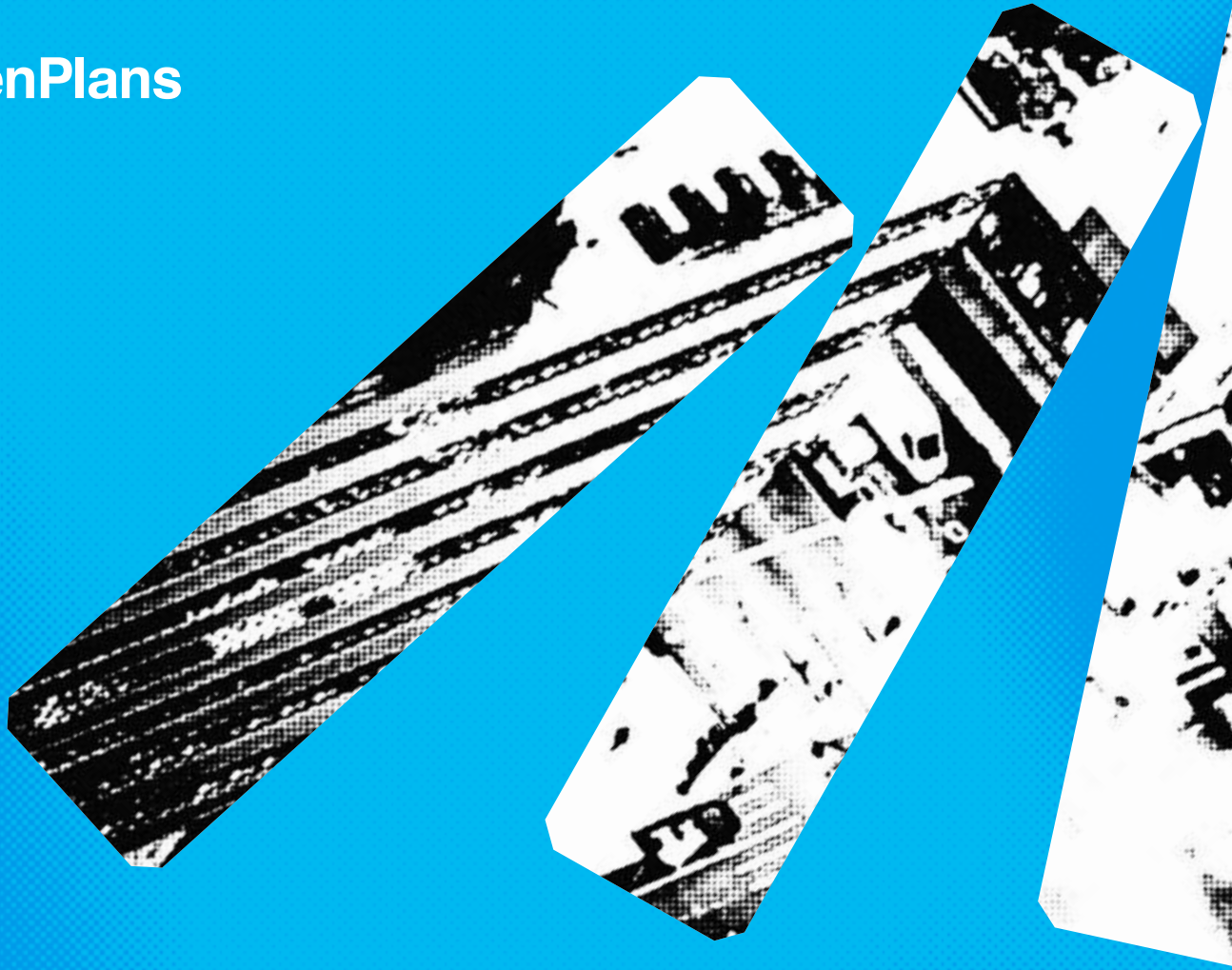


Curb the Chaos

Solutions for
Cities at the Curb





About Open Plans

Open Plans' mission is to transform how people experience New York City's streets.

Open Plans uses grassroots advocacy and policy change to inspire structural reforms and cultural shifts. We promote a people-first street culture that prioritizes community, safety, joy, mobility and empowerment.

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Executive Summary

In cities across the country, the curb is evolving. Due to people's rapidly changing needs, this narrow piece of our landscape located between the sidewalk and the travel lane has become extremely competitive in recent years. E-commerce, food delivery, for-hire vehicles, micromobility, and more have created increased demand for space at the curb. Cities across the country are responding by radically changing how this space can support people; no longer is it reserved solely for the storage of motor vehicles. This report aims to determine what strategies cities should prioritize to make a curb that works for more users. First, we lay out the current state of the curb and discuss the impacts of a chaotic curb on cities. Then, we name many of the most popular uses of the curb as well as their benefits, issues, and solutions to make them more efficient. We interviewed dozens of practitioners, curb users, and curb technology companies around the country and our analysis found four emergent themes in curb management. Additionally, we highlight case studies of how cities have successfully dealt with these themes. Finally, we make recommendations on how cities, including New York City specifically, can improve their curb management to make a more livable city.

Dynamics At the Curb

- Due to the influx of demand at the curb, space has become even more competitive, and uses other than long-term vehicle storage are being adopted.
- Neglecting to create infrastructure that accommodates these uses causes chaos at the curb.
- Drivers idling and double parking creates dangerous situations for all road users — placing pedestrians and micromobility users in life-threatening situations while creating even more traffic and congestion for other drivers.
- A serial undervaluing of the curb continues to place free long-term parking above all other uses which causes dysfunction at the curb.

Themes of Curb Management

- Through interviews with practitioners, users, and companies from across the country, four themes of curb management emerged.
- Designating what is traditionally known as the “parking lane” as a “curb lane” allows cities to better prioritize uses of the curb.
- Creating a curb management strategy allows for more comprehensive and holistic curb planning, improving efficiency and safety of a city's streets.
- Digitizing, coding, and standardizing the curb using the Curb Data Specification from the Open Mobility Foundation provides cities with the digital infrastructure to evaluate and improve their curbs.
- Creative enforcement of curb regulations — automated enforcement, smart loading zones, AI-powered enforcement — are the future of managing our curbs.
- Through case studies on Seattle, San Francisco, Omaha, and cities performing enforcement pilots across the country, we identify the way these cities have effectively dealt with the emergent themes of curb management.

Recommendations

- Designate and actualize the curb lane; clearly refer to it as such and place a diverse set of uses in the space
- Create comprehensive, neighborhood-based curb management strategies to plan the curb lane as part of the larger city-wide network while accommodating context-specific needs
- Consolidate internal data into CDS, work with external parties in that format, and make curb data readily available for the public
- Activate innovative automated enforcement pilots and leverage those pilots into permanent programs to better enforce the curb



Introduction:

The State of the Curb



In the past decade, the ways that we live our lives — and therefore the ways in which we interact with our curb — have changed drastically.

The rise of online shopping and e-commerce giants have introduced unprecedented levels of delivery in commercial and residential contexts. As of 2021, in New York City's five boroughs alone, 2.4 million packages are delivered daily.¹ Now, instead of being limited to commercial corridors, delivery trucks of all kinds make regular deliveries in residential neighborhoods as well, creating challenges for all road users.

Food delivery, too, has seen a rapid and massive proliferation. Instead of the relatively small and localized food delivery of the previous decade, practically every resident has dozens, if not hundreds, of restaurants at their fingertips. Even more, there is a fleet of drivers and cyclists ready to deliver these orders to all corners of a city at a moment's notice. The payment structures and incentive for app-based delivery workers to prioritize speed over all else presents a challenge in-transit and at pick up and drop off (PUDO).

For-hire vehicles (FHVs) have evolved far beyond taxis and car services as app-based rideshare has become widespread. As is the case with app-based food delivery, the general accessibility of FHVs presents a

host of problems with PUDO at the curb. Existing and new FHV options for those with mobility issues likewise present both logistical and urgent equity problems.

Due to a host of factors — including a number of start-ups entering the market, the climate crisis, and a general desire for non-vehicle mobility — micromobility devices like bikes, e-bikes, and scooters have become more widespread in cities. Micromobility has emerged rapidly as a convenient and joyful way to get around cities; these devices are here to stay, and accommodating them presents a number of emergent infrastructure needs. Wider micromobility travel lanes, shared micromobility corrals and docks, and micromobility storage all intersect with the curb.

The first waves and ongoing echoes of the COVID-19 pandemic created appetite for new curb uses and supercharged some of these uses that have become more widespread. For one, open-air public space has become more in demand, and as a result parklets, outdoor dining (streeteries), and open streets have proliferated. These fledgling uses of the curb, in some cases, reallocate a significant amount of curb space (sometimes including the entire



< The frequency of modern-day package delivery, especially in dense cities, presents a number of logistical challenges for both cities and freight operators.

> Delivery apps make it so that anyone has the ability to order anything to their door within minutes — the vehicles and micromobility devices used to carry out these deliveries must be accommodated in a city's infrastructure.





Bus lanes located in the curb lane have been used by cities to reduce delays, increase ridership, and encourage mode shift.



The pandemic supercharged the demand for open-air spaces, which led to the proliferation of streetery programs like the Open Restaurants program in New York City.



street), and require attention, funding, and standardization in order to allow them to flourish. Additionally, deliveries of all kinds — online shopping, grocery, food — boomed under the pandemic, and this trend continues today.

These massive shifts in the way we use our curb require infrastructure that adapts to and accommodates these uses. However, in most cities across the country, the primary use of the curb remains free private vehicle storage. Free parking is a massively inefficient use of the curb and contributes to an endemic undervaluing of the curb. Proper management of the curb requires good parking management, but it also requires planners to think of the curb beyond just a parking lane. Without this, we are left with chaos at the curb.

For New York City, the most dense major city in the United States, these issues are amplified tenfold. The city's density means that there are more residents and businesses receiving deliveries by truck, car and bike, more patrons of FHV's, and more users of all types of micromobility.

Take this alongside the increased demand and need for these uses, and logistics can get messy quickly. Because of this, it is absolutely vital that New York City properly manage its curb.

In this report, by using evidence from interviews with curb practitioners from around the country, users in New York City, and technology companies, we lay out a roadmap for cities to follow to resolve their chaos at the curb. While this report will, at times, pay specific attention to New York City, this report is meant to be used by cities of all sizes and types.

First, we describe the current conflicts at the curb and the uses that occupy the space. Then, we draw from our interviews with curb experts from around the country to identify four key themes of modern curb management. After providing case studies of cities that have successfully tackled each of these themes, we recommend specific courses of action for cities to take on each front. Together, this report aims to be a blueprint for cities at any step of improving their curb management.

While this report will, at times, pay specific attention to New York City, this report is meant to be used by cities of all sizes and types.

Methods

Many cities learn by observing and replicating what is done in other cities around the globe, and this report is designed with that premise at its core. Understanding what has worked in the past and what is working now is crucial to understanding what will work in the future. Important, too, is understanding how users interact with the curb and what improvements they require. To do this, we engaged in the following research methods:

Review of Literature & Strategies

We conducted a holistic review of the literature on curb management. This included reports and studies from governments around the globe, academics in the field, technology companies, and advocates on the ground. We also conducted a non-systematic review of curb management strategies in cities across the United States. To do this, we reviewed strategies of the leaders in the field and identified pilot programs of policies and studies in cities across the country.

Practitioner Interviews

We conducted interviews with municipal workers who manage curbs in their cities. Practitioners in 12 cities from Transportation, Public Works, Infrastructure, Mobility, and Parking Departments spoke with us about the challenges they face at the curb, insights from their experiences, and solutions they've identified.

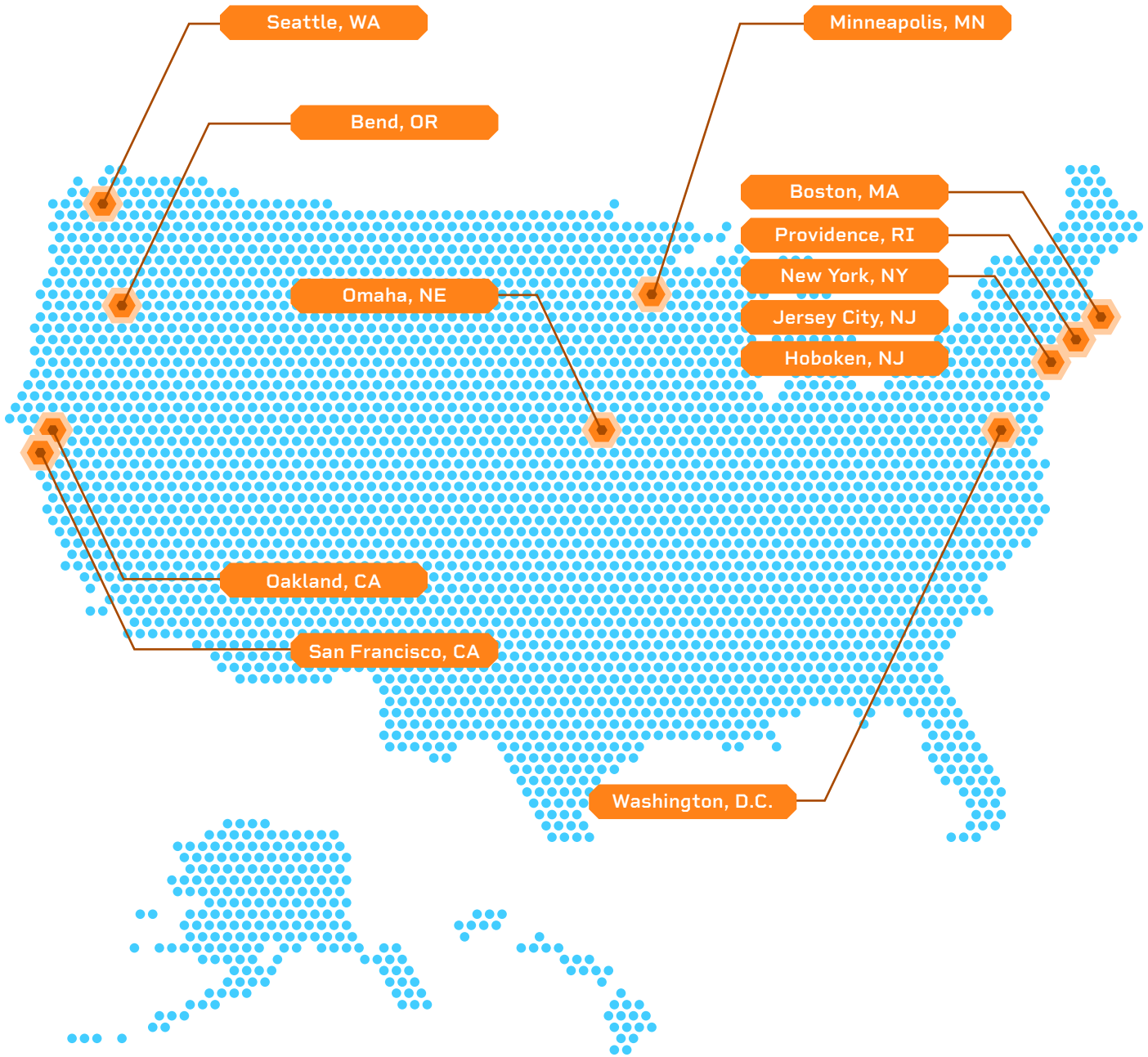
This sample of localities was gathered by first interviewing the foremost leaders in curb management, identifying potential interviewees through inquiry and research, and connecting with them through professional networks. This sample, while not completely exhaustive, is relatively representative of the different challenges posed by city size, geography, climate, and existing curb infrastructure.

Curb User Interviews

We spoke with key users of the curb. These users are meant to be representative of the competing interests at the curb, both community and commercial. We identified the most contentious and prevalent uses of the curb, and identified key stakeholders that best represented these interests in a way that would be applicable to most cities. Many companies interviewed operate in dozens of cities around the country, and the insights gained from organizations local to New York City are transferable to other localities.

Curb Management Technology Interviews

We spoke with companies executing new technologies at the curb. Leveraging technology is a vital part of managing the curb in the 21st century, and companies identified potential opportunities and barriers for implementation. We identified key technologies being used at the curb, and engaged with companies utilizing that technology in cities across the country.



During the course of our research, we spoke to a dozen cities across the country about their approaches to curb management.

Findings:

Impacts

of a

Chaotic

curb

There is overwhelming evidence to show that when infrastructure at the curb does not accommodate the wealth of uses that exist, it harms all users. Pedestrians, micromobility users, and even drivers are harmed by a curb that single-mindedly prioritizes free parking over all other uses.

Due to the lack of infrastructure and enforcement, passenger and commercial vehicles often double park and idle in the travel lane, curb lane, and bike/bus lane. This creates a congested and chaotic situation that is dangerous for all road users: drivers are forced to maneuver into oncoming traffic to pass, cyclists and delivery workers have to ride on the sidewalk or into road traffic, and pedestrians are vulnerable to all of these altered paths. As should-be curb uses spill over into travel lanes, congestion increases and drivers sit in traffic longer, increasing trip time and gas usage. The increasing multitude of uses at the curb exacerbate this problem. In New York City, for example, parking violation tickets rose by 30.6% for passenger vehicles and 14.1% for commercial vehicles from 2014 to 2018, and complaints to 311 about illegal parking rose by 658.2% from 2010 to 2019.²

Due to issues finding consistent spaces for loading, many companies view commercial parking fines and tickets as a cost of doing business. Freight managers note that, often, it is more financially sound to simply pay tickets and fines rather than spending time and fuel endlessly circling trying to find a parking space or loading zone.³ Large freight operators have the ability to eat these costs, but there is an inherent risk for smaller operators; too many fines can result in trucks being condemned and livelihoods lost.⁴ This all-too-common practice — standardized in some jurisdictions like New York City with its stipulated fine program — creates disruption in our streets and unnecessary conflict between users.

In addition to freight operators, due to a lack of dedicated pick up locations, FHV operators often have little choice but to double park or idle in restricted locations. The proliferation of ridesharing apps has placed countless more



^
The adoption of micromobility as a joyful and efficient mode of transportation introduces the need for vital infrastructure; without it, curb users are drawn into unnecessary conflict with one another.

FHVs on the road — daily FHV trips have more than doubled in the past decade — and without sufficiently accommodating them, our streets become more congested and dangerous.⁵ This is true for paratransit as well. Curb users we spoke to explained that paratransit operators drop off riders far from their desired destination, forcing them to complete their trip on-foot and/or using a mobility device. This makes paratransit more difficult for riders to use, ultimately lessening the increased mobility paratransit can provide and negating the very benefit of the program. This highlights the need for dedicated space for FHV pick up and drop off, including for paratransit.

All of these factors contribute to a general lawlessness on our curb and in our streets. Residential and commercial vehicles are forced (and in some cases,

choose to) idle or park where they're not meant to, which creates spillover effects for micromobility users, pedestrians and other vehicles. Once a road user sees repeated unpunished flagrant violations at the curb, it emboldens them to do the same. And by and large, agencies across the country lack the ability to consistently and proactively enforce their curbs.⁶

There are also inherent issues with the curb itself being undervalued. By prioritizing private vehicle storage at the curb, cities are prioritizing one of the least productive uses of the curb rather than leveraging the value of the curb. In contrast, techniques like dynamic pricing not only serve to manage demand at the curb, but also generate revenue that can be used for things like street and public transportation improvements. **A pilot from San Francisco resulted in a 43%**

All of these factors contribute to a general lawlessness on our curb and in our streets.

decrease in time to find a parking space as well as increasing net parking revenues by roughly \$1.9 million per year.⁷ Some cities like Philadelphia and Oakland are piloting “smart loading zones” that would make it easier and more efficient for commercial vehicles to pay for their use of the curb.⁸

Maintaining free parking as the default curb use perpetuates the cycle of car-dependency in cities. Initiatives to encourage walking, biking, and public transit usage have a deeply dampened effect if a city remains car-dependent.

Continuing to prioritize free parking at the curb encourages on-street parking even in the face of available off-street parking, and actually increases car ownership by nearly 9%.⁹ Increased car ownership further congests streets, increases the amount of cars on the streets cruising for spots, and creates more demand for parking, all of which have an additional harmful effect — exacerbating the climate crisis. In the end, prioritizing free parking over all else harms all users, including drivers.



Without properly mediating the relationship between the curb, freight, and regulations, users are forced to fend for themselves. In this image, although there is a loading zone, this delivery is taking place outside of the loading zone's designated days, resulting in a blocked crosswalk, reduced pedestrian and driver visibility, and unnecessary double parking.





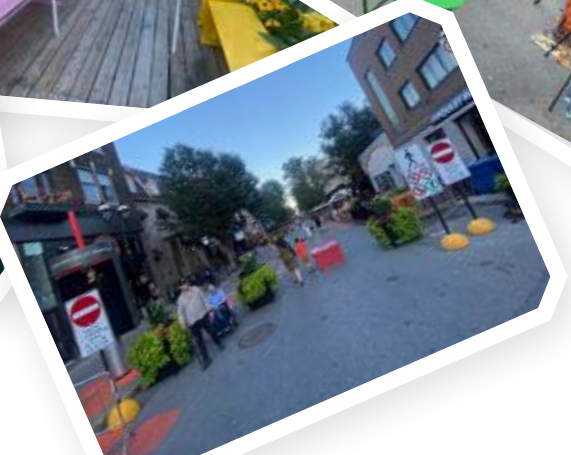
Findings: Uses of the Curb

There are countless potential uses of the curb. The following is an extensive, although not exhaustive, list of curb uses along with their benefits, potential issues and conflicts they present, and solutions to remedy those issues.

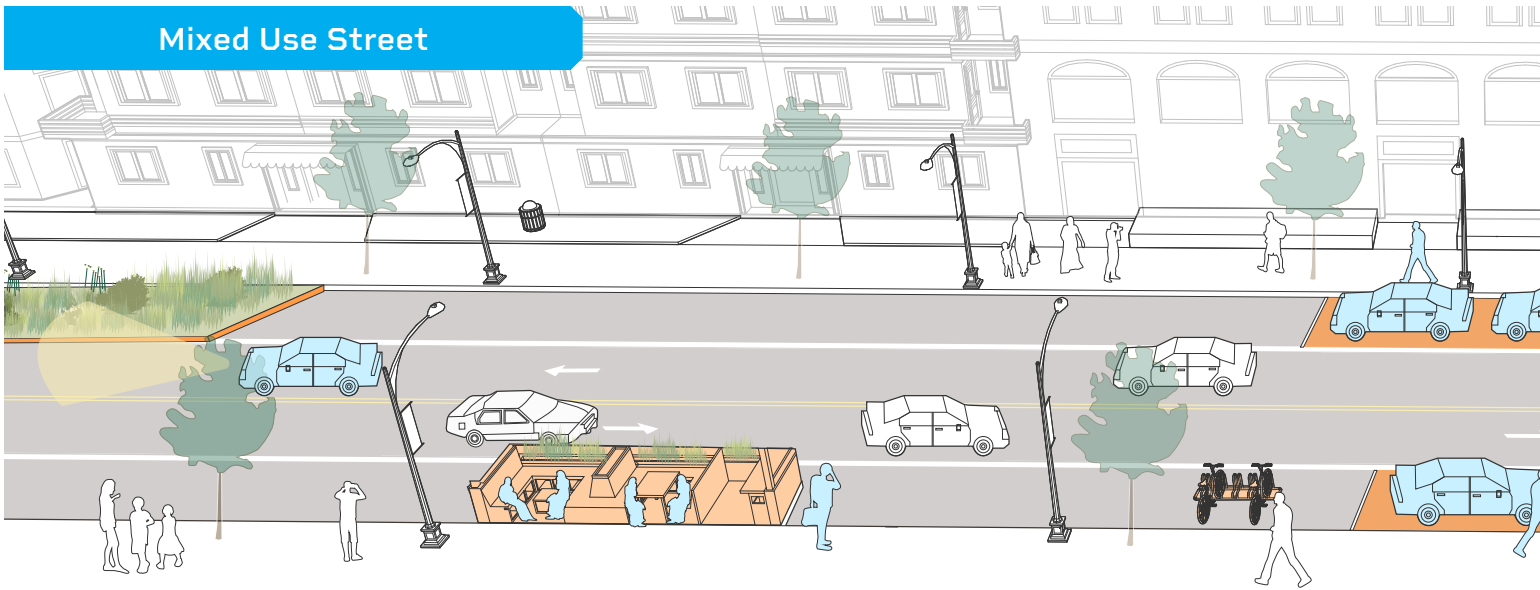
It is worth emphasizing that free parking and the car culture it creates conflicts with virtually every other use of the curb. It creates a sense that any unoccupied space at the curb is by definition free parking, and that any other use — a loading zone, a carshare spot, or a bike lane, for example — is an exception that must be fought for one spot at a time. By listing the various uses of the curb, we are highlighting the different ways in which the curb can be used — ways that

are more efficient, more effective, and more communal.

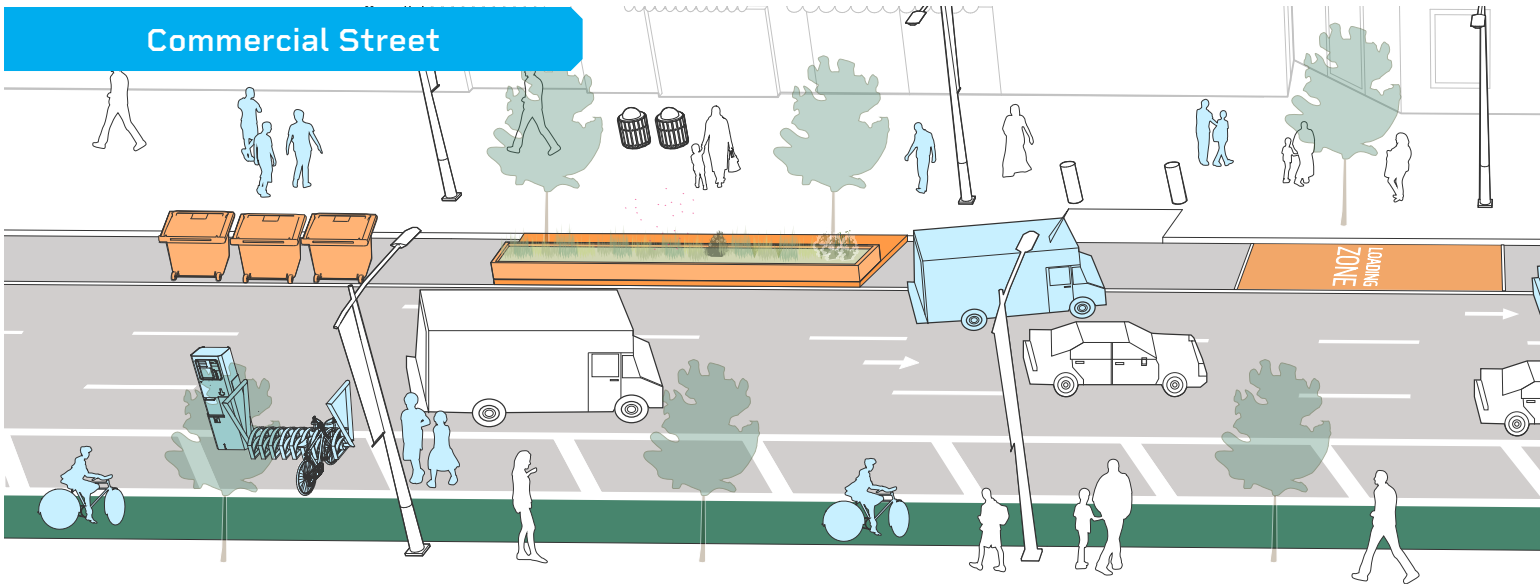
Uses are divided up into four categories — access for people, access for goods, community, and storage. They are inspired by the divisions present in the San Francisco and Seattle curb hierarchies, and are later represented in our recommendations for New York City. Another category, which represents mobility priorities for cities (Streets Plan Mobility Priorities for New York City) will depend on each city and span the aforementioned categories. However, uses that are included in the NYC Streets Plan will be denoted under each use and can be generally understood as mobility priorities.



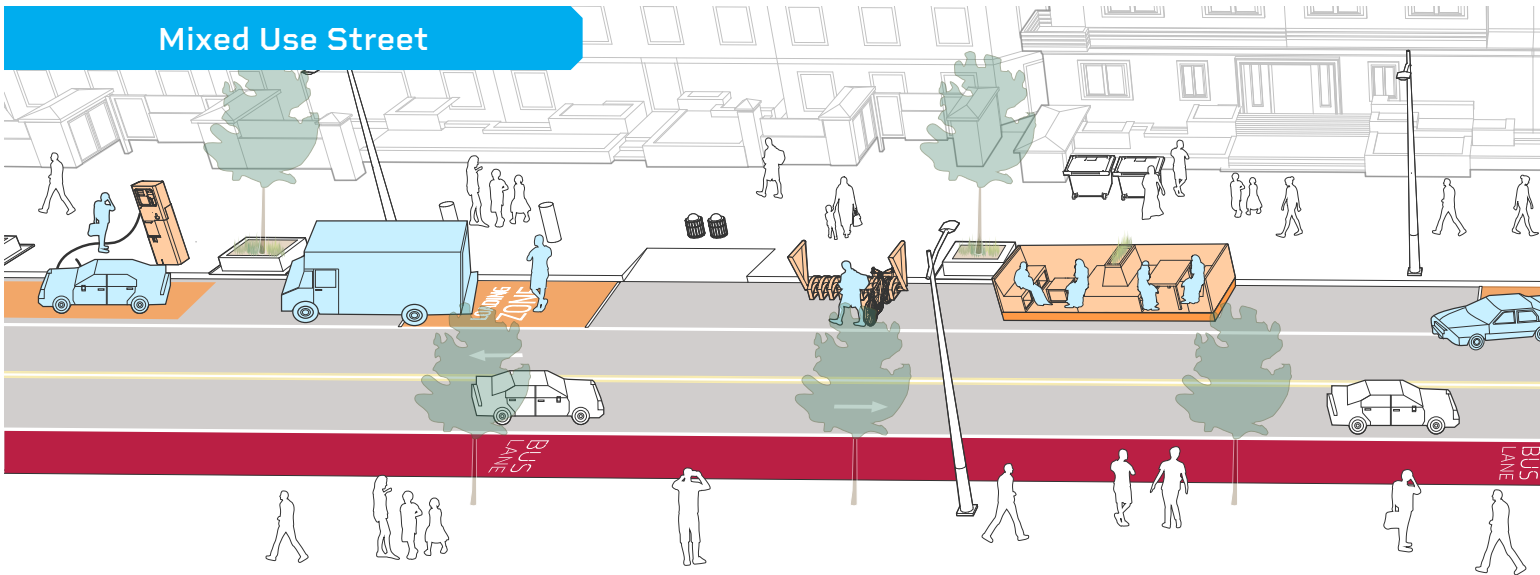
Mixed Use Street

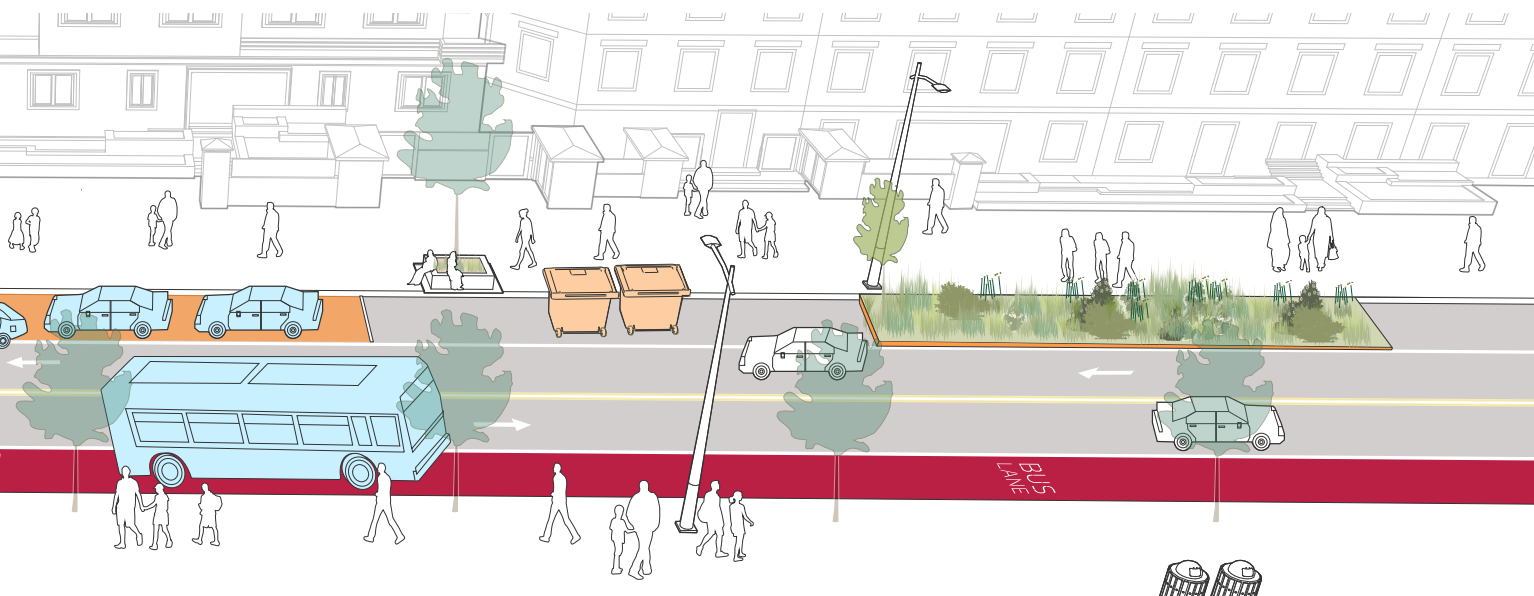
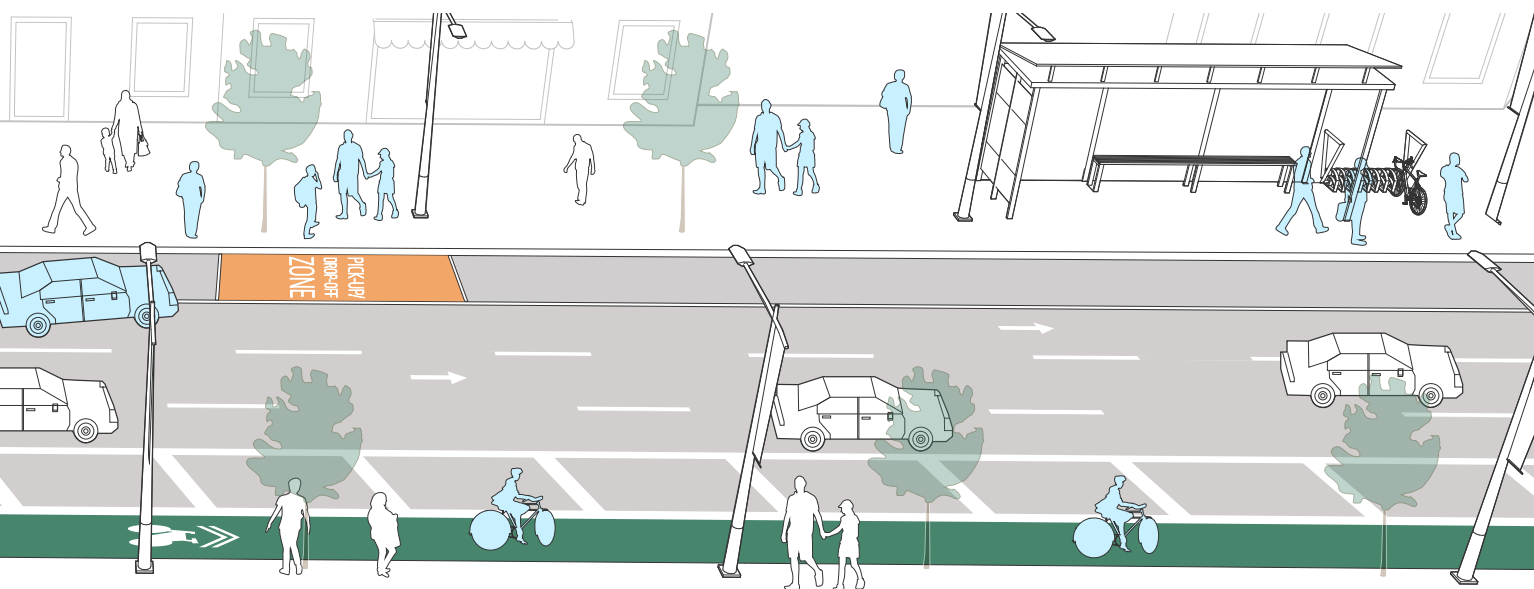
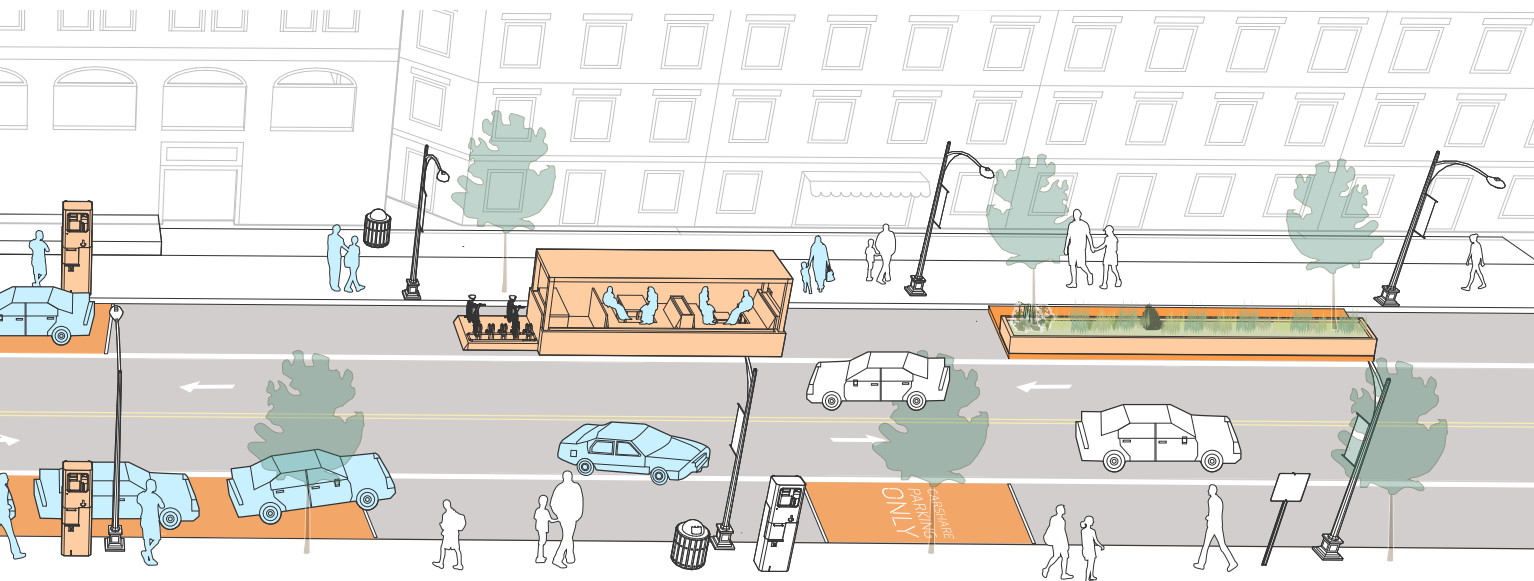


Commercial Street



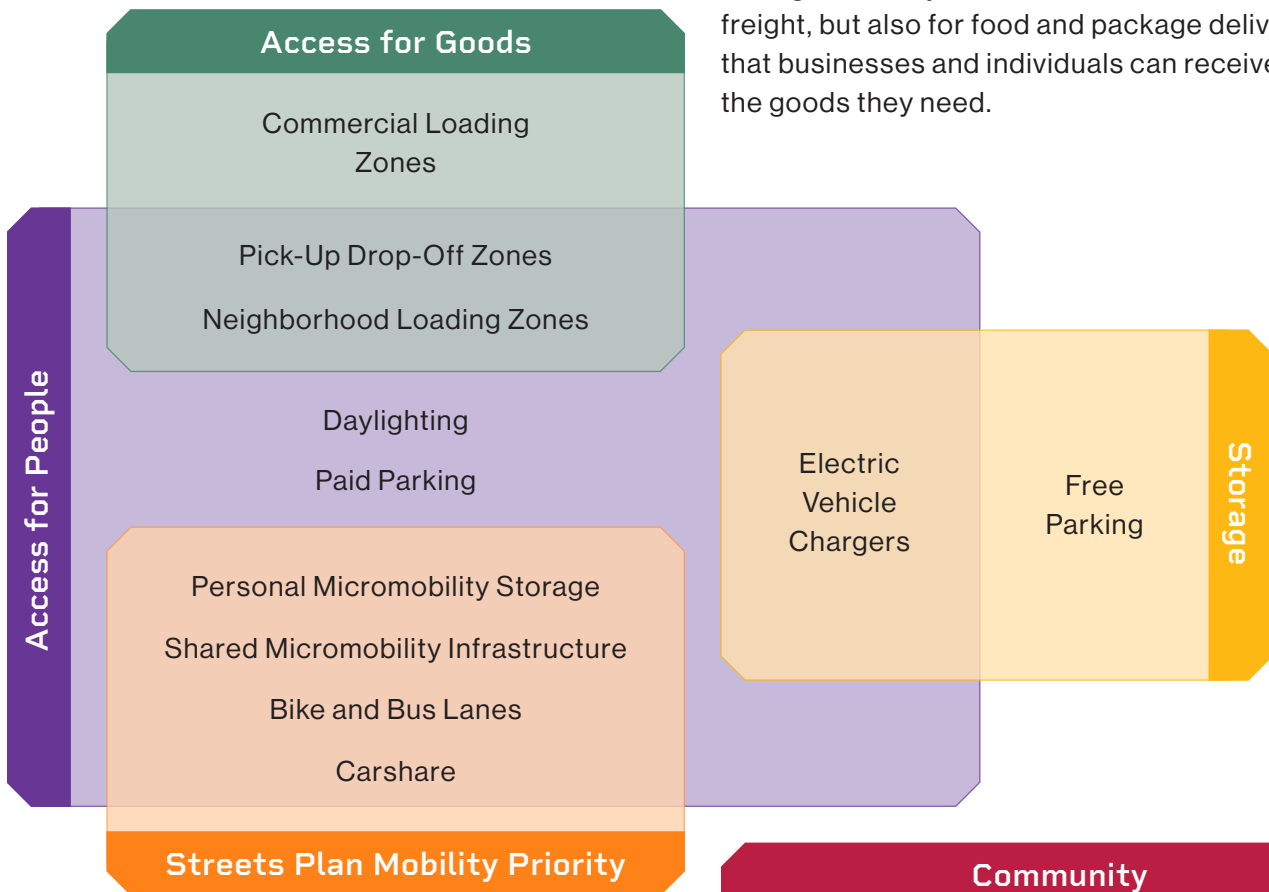
Mixed Use Street





Access for People

Uses that provide access for people allow residents to get to and from places in their city through a variety of modes — public and active transportation, on foot, and in some vehicles. These uses allow them to utilize these modes with safety, reliability, and efficiency.



Community

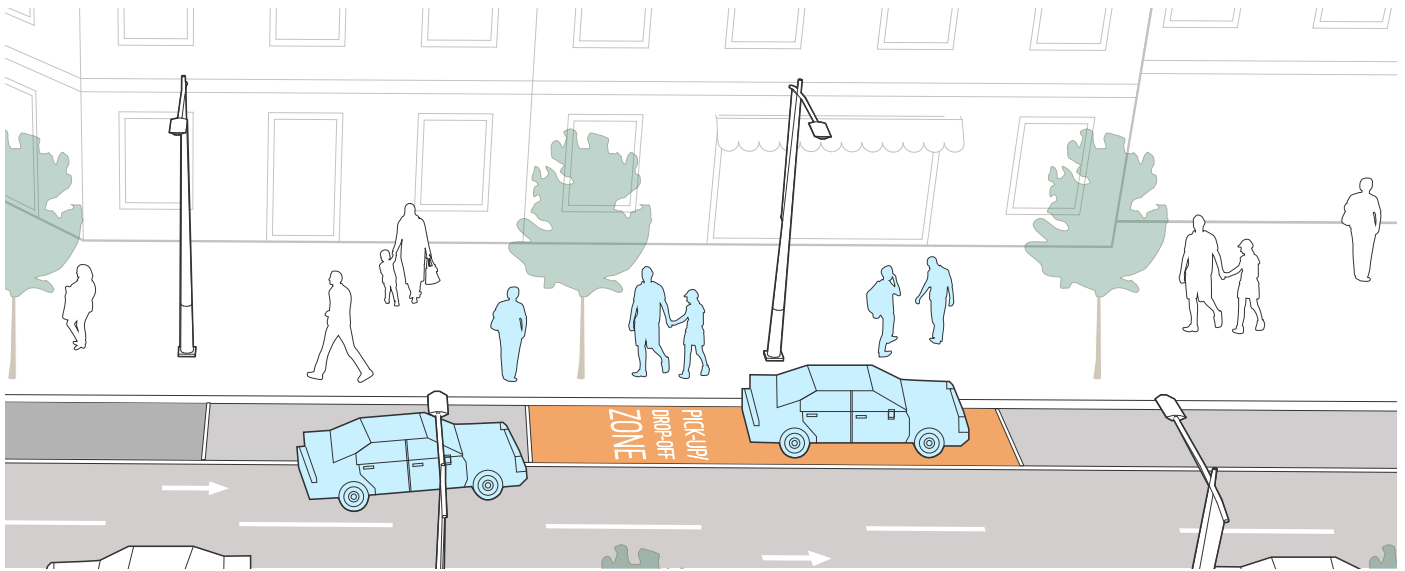
Uses that are accessible and centered around community foster a sense of place and accentuate the joyful potential that our cities, streets, and curbs have. They provide essential infrastructure to ensure that communities can use the curb to its fullest potential.

Access for Goods

Uses that allow access for goods provide infrastructure for vital commerce to flow throughout a city. This includes infrastructure for freight, but also for food and package delivery so that businesses and individuals can receive the goods they need.

Storage

Uses that provide storage allow for the long-term, free storage of private vehicles at the curb. This use makes up the majority of curb use, provides the least benefit, inefficiently uses space at the curb, and conflicts with every other potential curb use.



Pick-Up Drop-Off Zones

Access for People

Access for Goods

Pick-up drop off-zones (PUDO zones) are specially designated curbside areas that allow for-hire vehicles, food delivery, or paratransit vehicles to park short-term (often five to ten minutes) in order to pick up or drop off people or goods.

Benefits

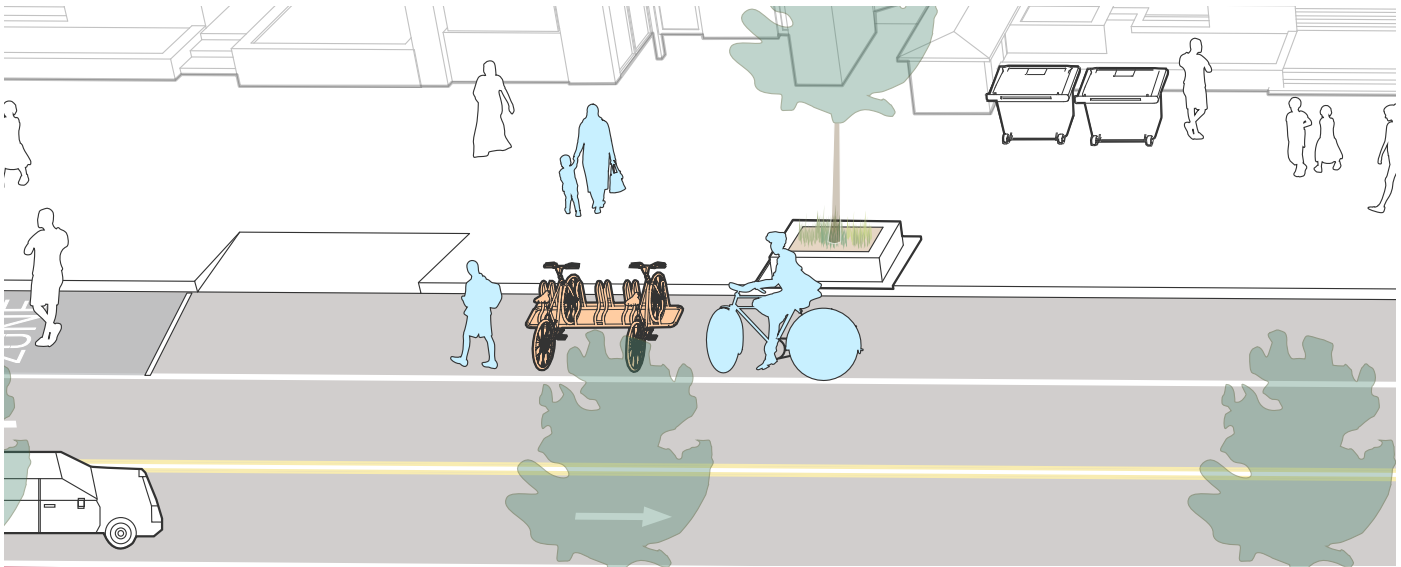
- Providing outlets for PUDO can lower the number of vehicles illegally parked, especially those double parked, decreasing congestion and increasing safety.
 - » Nightlife PUDO pilots in the District of Columbia yielded positive results in safety, congestion, and stakeholder feedback.¹⁰
- By limiting illegal vehicle parking, conflict between users — FHV idling in a commercial loading zone, for example — is avoided.
- Paratransit PUDO zones play a part in increasing the mobility of those who rely on paratransit by providing them a reliable, accessible place to be picked up and dropped off.

Issues & Conflicts

- Clear signage along with communication to the public and stakeholders is essential, otherwise there may be confusion or conflation between PUDO zones and commercial loading zones.
- PUDO zones — especially paratransit PUDO zones — may face pushback from businesses that do not immediately benefit from them.
- Due to built-in incentives for app-based FHV and food delivery drivers — who are paid per trip/delivery as opposed to hourly — some still may circumvent this infrastructure for the sake of speed.

Solutions

- Increased enforcement of illegal parking, especially double parking, should go hand in hand with more PUDO zones to incentivize behavior shifts.
- Cities should perform outreach campaigns to business owners on the benefits of PUDO zones near their businesses.
- Cities should remove the built-in incentive for food delivery drivers to prioritize speed by requiring companies to provide workers an hourly, living wage.



Personal Micromobility Storage

Access for People

Streets Plan Mobility Priority

Personal micromobility storage provides places for individuals to securely store their bikes, scooters, or any other micromobility. Personal micromobility storage usually takes the shape of bike corrals or racks, but there are a number of innovative secure micromobility storage products, like bike pods, entering the market.

Benefits

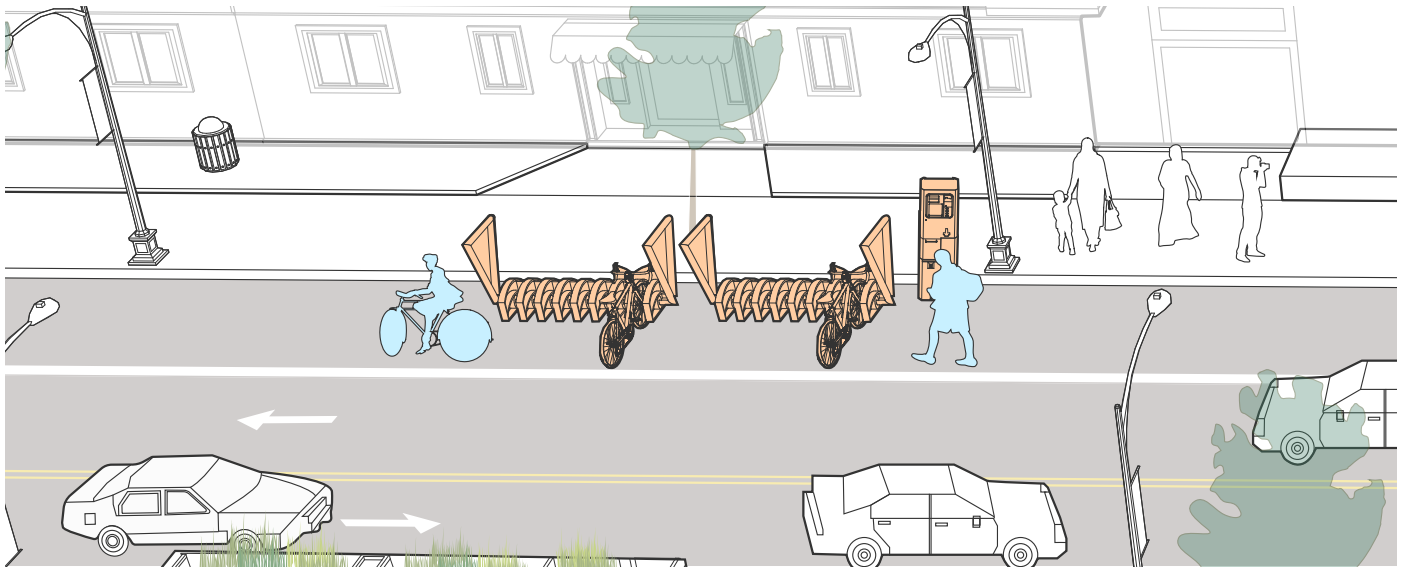
- With sufficient micromobility storage options, it is more rational for residents to own and use micromobility.
 - » Studies have shown that bike parking infrastructure encourages cycling.¹¹
- Micromobility storage infrastructure that is safe and secure reduces micromobility theft and puts residents' minds at ease.

Issues & Conflicts

- Storage infrastructure must be maintained, which sometimes requires local maintenance partners.
- Private companies offering secure bike parking present procurement and contracting issues.

Solutions

- Cities can take on maintenance themselves or provide either monetary or operational support to private partners to provide maintenance.



Shared Micromobility Infrastructure

Access for People

Streets Plan Mobility Priority

Shared micromobility infrastructure, like docks and corrals, are where bike-share and scooter-share devices are stored. They can be physical infrastructure where micromobility devices are placed in docks or areas that are cordoned off for devices to be stood up, awaiting use.

Benefits

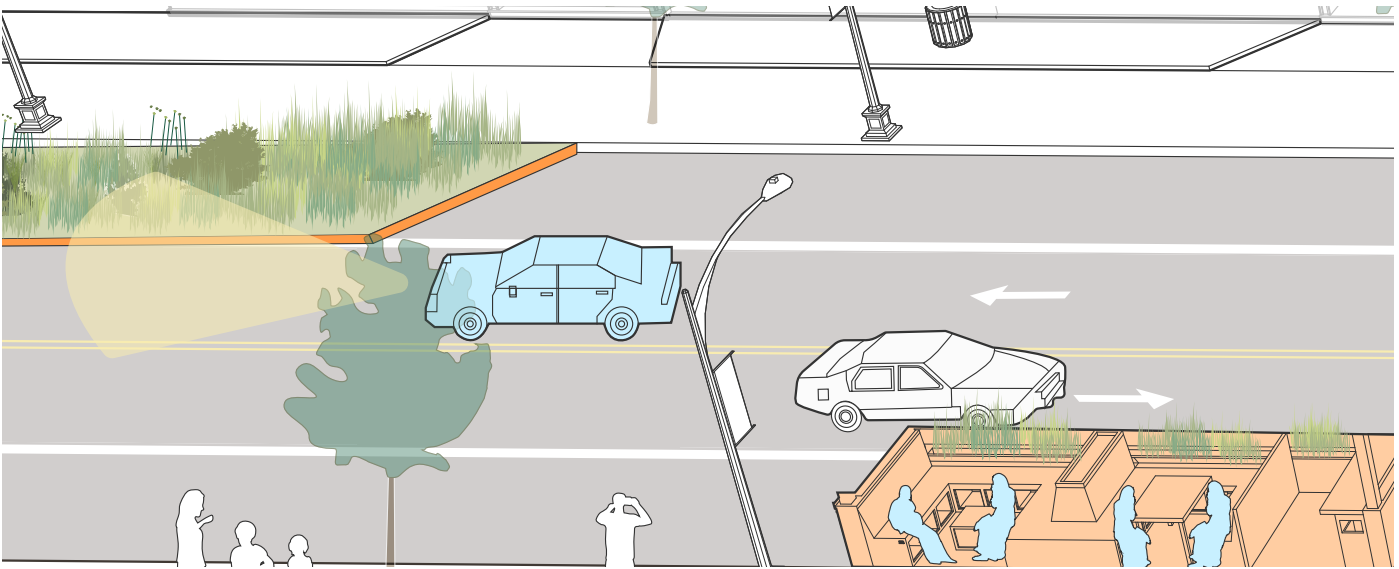
- Bike and scooter-share allows residents to access micromobility easily without having to worry about personal storage.
- Easy, affordable, and widespread access to shared micromobility devices encourages the general public to use active transportation.

Issues & Conflicts

- Shared micromobility stations that require permanent infrastructure can be expensive to install.
- Dockless micromobility can create confusion about parking zones and disorderly sidewalks.
- Cities must consider the financing of shared mobility and whether it will be treated as public transportation.

Solutions

- Dockless micromobility share should include specific parking zones to limit confusion and disorder on sidewalks.
- Cities should work alongside micromobility companies to proactively ensure the community are aware of how to ride, use, and store micromobility.



Daylighting

Access for People

Daylighting is a street safety technique that increases visibility by removing parking within 20 to 25 feet of an intersection. Doing this allows improved sightlines for drivers, cyclists, and pedestrians. A daylit zone may be painted in stripes or bold colors, or a variety of features can be placed to avoid illegal parking like boulders, planters, bioswales, shared/individual micromobility corrals, sidewalk bump outs, and more.

Benefits

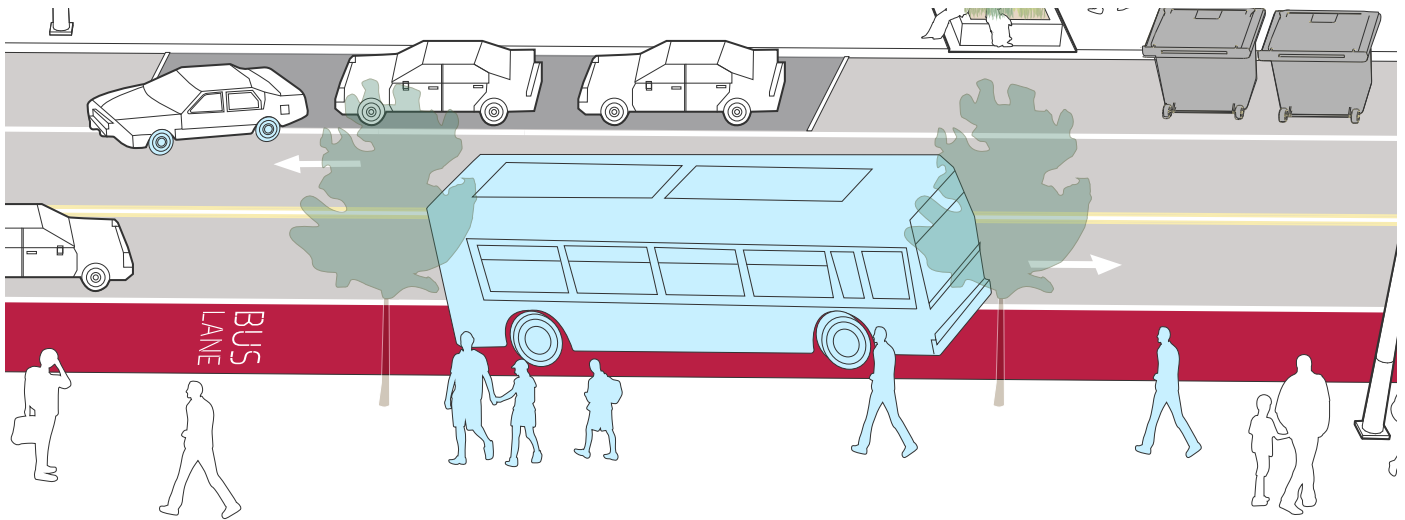
- Daylighting intersections has been proven to improve safety for all road and curb users.
 - » Hoboken, New Jersey had zero traffic deaths from 2018 to 2022, largely due to its widespread daylighting program.¹²
- Depending on the structure placed in the daylit zone, there can be a number of benefits.
 - » Features like planters and bioswales help make the city greener.
 - » Micromobility corrals encourage active and shared forms of transportation.
 - » Boulders can provide informal seating and bump outs provide additional pedestrian space and shorter crossings.

Issues & Conflicts

- Without something in the space to prevent illegal parking (like a boulder or planter), it can become de facto free parking.
- Without something in the space to prevent sharp turns, turns at the intersection can be more dangerous.

Solutions

- Whenever possible, cities should introduce a physical structure (a boulder, planter, or micromobility dock for example) in order to ensure areas stay daylit.



Bike & Bus Lanes

Access for People

Streets Plan Mobility Priority

Bus and bike lanes are travel lanes where only the corresponding mode of travel can navigate. They are usually demarcated by paint, and sometimes physically separated from vehicle traffic; bike lanes can be separated by parked cars, bollards, or any other physical barrier, and bus lanes can be physically separated from other vehicles.

Benefits

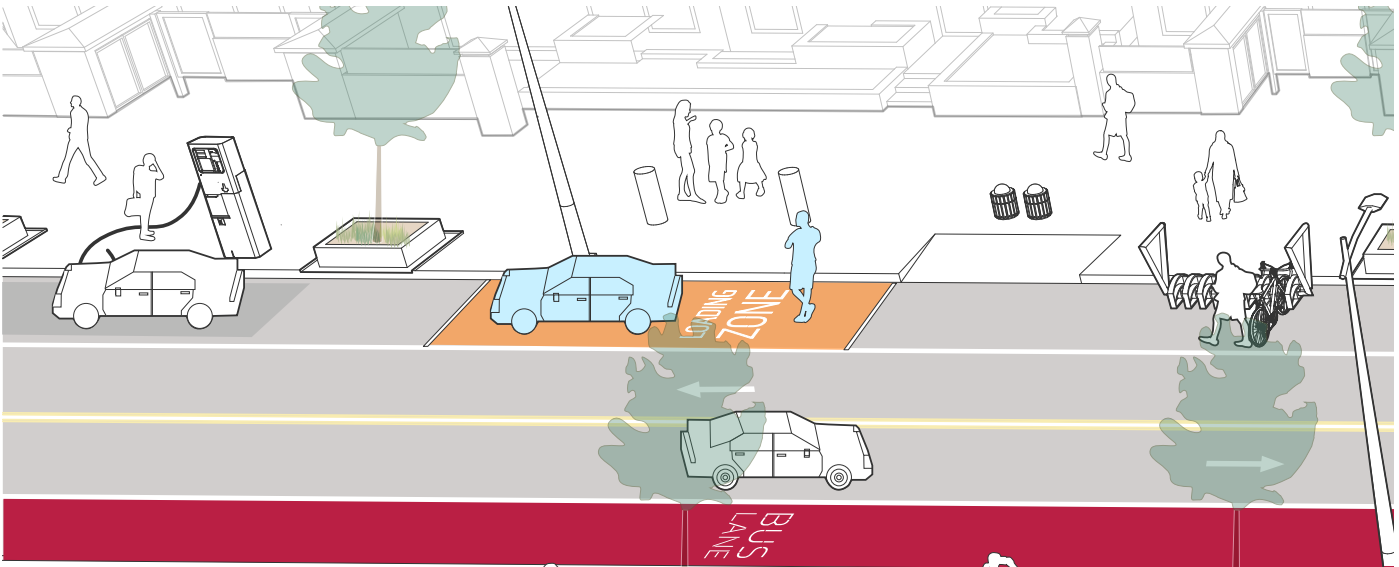
- Bus lanes are proven to reduce bus delays and increase ridership on those routes.
 - » In New York City, implementing Select Bus Service on routes resulted in up 20% faster trips and 10% increased route ridership.¹³
- Protected bike lanes help the adoption of cycling for transportation by providing safe and reliable infrastructure for riders.
- Generally, providing infrastructure for public transit and biking increases the ridership and adoption of these modes.

Issues & Conflicts

- Bike and bus lanes prevent any other curb use from occupying that space.
- Unprotected bike lanes are insufficient in protecting cyclists' safety.
- Bus lanes that are not physically separated and/or are not enforced often become parking lanes or are frequently blocked by temporarily parked vehicles using the lane for pick up drop off or unloading.

Solutions

- New technology to issue tickets for illegal parking in bike and bus lanes can create behavior shifts and should be explored by cities.
- Where possible, cities should protect bike and bus lanes in order to improve safety and efficiency.



Neighborhood Loading Zones

Access for People

Access for Goods

Neighborhood loading zones (NLZs), designated in residential areas rather than commercial corridors, allow non-commercial vehicles to park short-term to do things like take in groceries, unload luggage, or any other use that may only require a short-term use of the space. Signage and paint can designate these zones.

Benefits

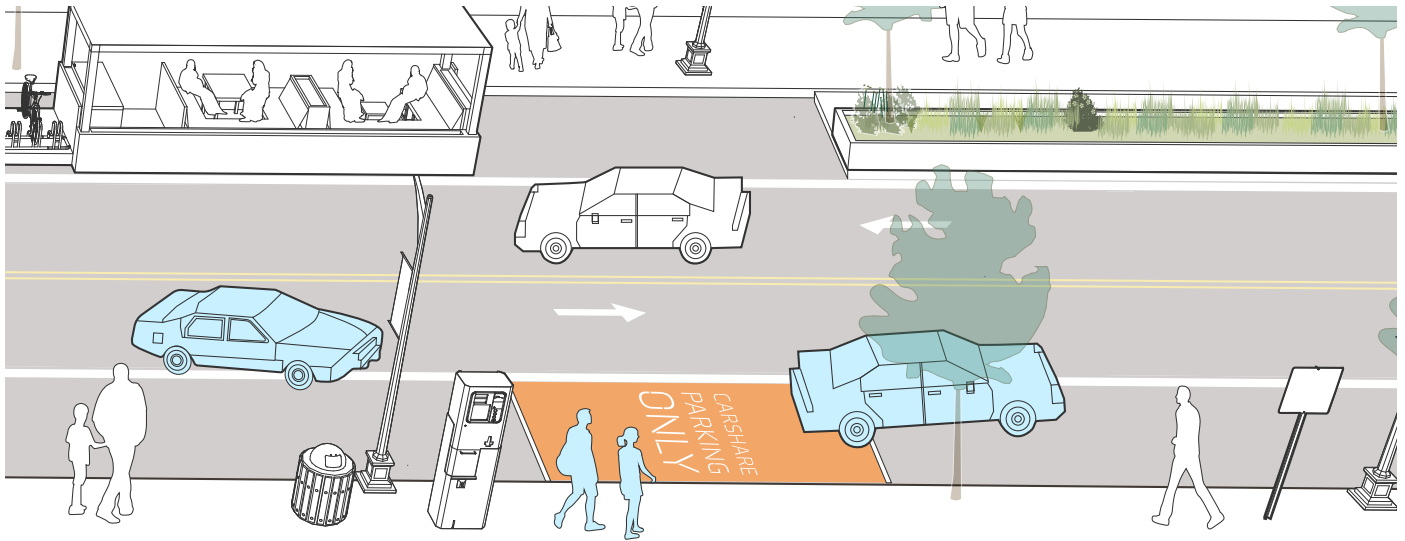
- Providing space for residents to drop off or pick up goods or people (bringing in furniture or picking up an elderly family member, for example) helps reduce double parking for loading reasons.
 - » A pilot program in New York City found that some sites with NLZs observed a 73% reduction in double parking.¹⁴

Issues & Conflicts

- If neighborhood loading zones aren't enforced, vehicles will likely illegally park in them, making them effectively useless.

Solutions

- Sufficient signage and enforcement ensures that all users are aware of the NLZ, and that it is being used properly.



Carshare

Access for People

Streets Plan Mobility Priority

Carshare allows for app-based, short-term vehicle rental services. Such spots at the curb are typically designated by signage, paint, or a combination of the two. Residents can receive the benefits of a vehicle without owning it, avoiding some of the outsized personal, logistical, and climate impacts of private vehicle ownership. For example, residents can use carshare to run an errand that may be difficult or impossible using active or public transportation and then return the vehicle to its designated spot for another resident to use.

Benefits

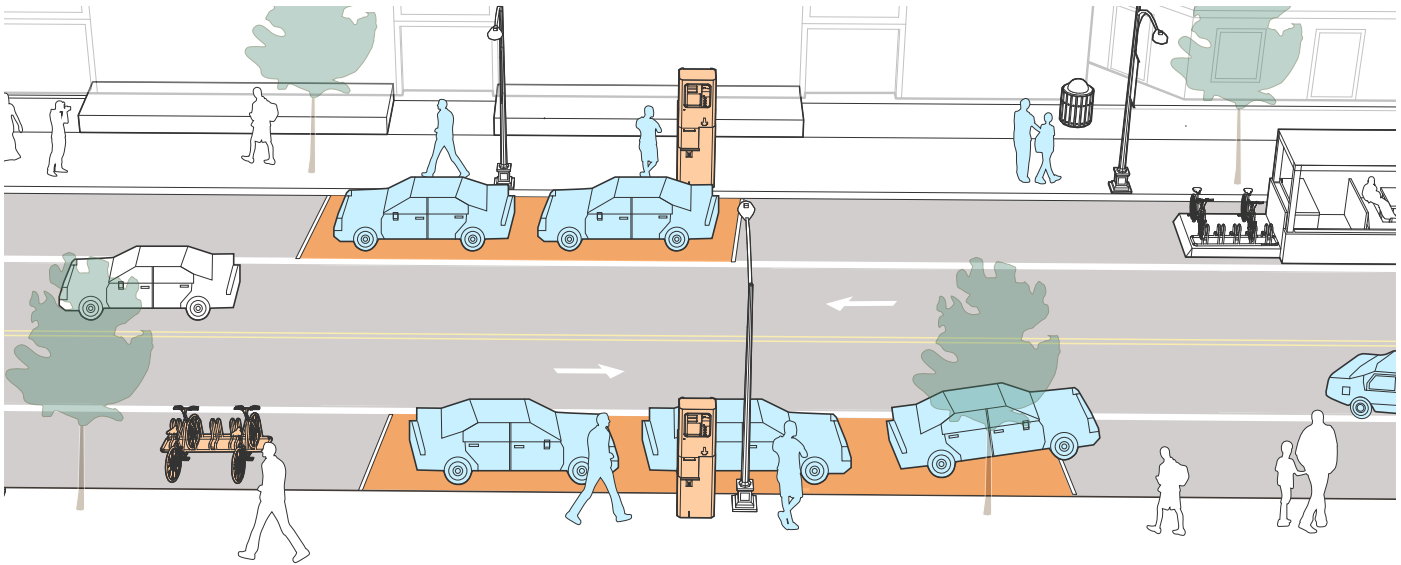
- Carshare allows more residents to get utility from a parking spot rather than the spot being used for one household's vehicle.
 - » In a New York City pilot, an average of 17 unique members used vehicles in each space each month.¹⁵
- Carshare particularly benefits low-income households, as car ownership is costly. This access allows them increased mobility.
 - » Carshare companies working with cities can and do provide low-income households with discounted membership.¹⁶
- Providing an on-demand, short-term alternative to car ownership may reduce car ownership overall, therefore reducing parking demand and increasing available parking.
 - » One carshare vehicle can take up to 13 privately owned vehicles off the road.¹⁷

Issues & Conflicts

- If the spot is occupied illegally when a carshare user is returning, it may result in a conflict between users and/or unnecessary circling or idling for a spot.
- If illegal occupancy of carshare spots is frequent, it may cause existing members to opt out of the program and discourage new members from joining.
- Lack of active maintenance by the company, which is usually tasked with maintaining the designated carshare spot and surrounding parking spots, may result in accessibility or mobility issues.

Solutions

- Painted spots and clear signs can help prevent illegal parking.
- Automated enforcement can also be used as a way to change individual driver behavior.



Paid Parking

Access for People

Paid parking requires drivers to pay either a flat or dynamic fee for the time they are parked in a given space.

Benefits

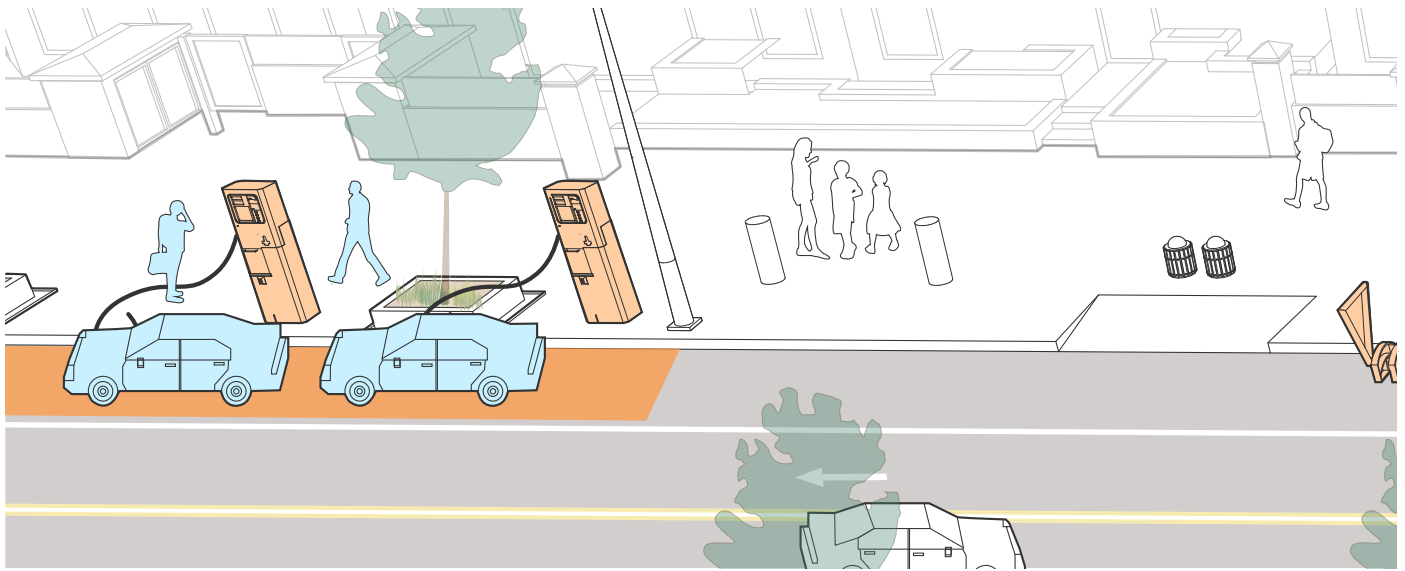
- Dynamic pricing at the curb has been shown to make city curbs more efficient.
 - » San Francisco's demand-responsive pricing pilot resulted in a 43% decrease in time to find a parking space, an 8% decrease in traffic, and a 22% decrease in double parking.¹⁸
- Parking revenue generates important funds that can be put towards funding infrastructure for public transit and active modes of transportation.

Issues & Conflicts

- Even though it is priced, metered parking that is not dynamically priced often still undervalues the curb.
- Dynamic pricing systems can be complex to implement on a citywide scale.
- There is significant public outreach necessary when making pricing changes at the curb.
- Cities that come to rely on revenue from paid parking may be reluctant to use the curb lane for other uses.

Solutions

- Clear signage and communication to the public about price changes at the curb can ease the transition period.
- Efficiency should always be prioritized over revenue when making changes to the price of parking at the curb.



Electric Vehicle Chargers

Access for People

Storage

Curbside electric vehicle (EV) charging designates specific spots in the curb lane that can only be used for charging rather than general parking; the chargers themselves are typically placed on the sidewalk. Often, these chargers take hours to fully charge vehicles and are priced to be competitive with gasoline.

Benefits

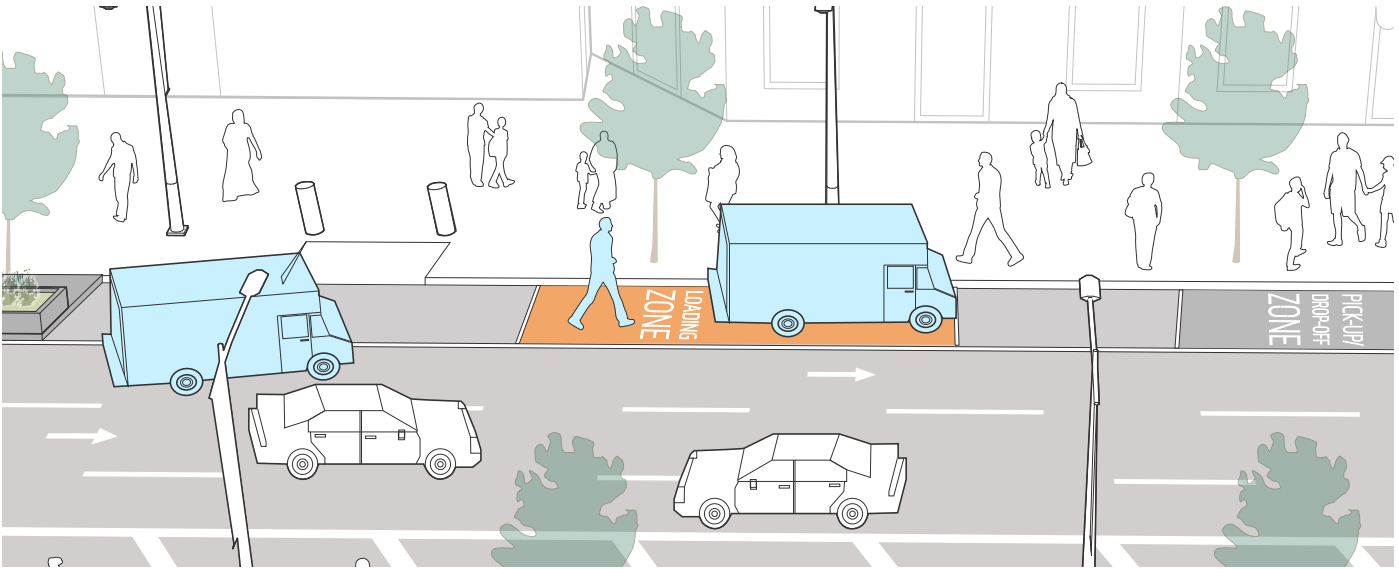
- Accessible EV charging encourages electrification by providing easy access to charging infrastructure.
- Placing EV charging curbside is a convenient location for charging for those who own an EV and do not have off-street parking.

Issues & Conflicts

- Installing EV infrastructure essentially locks in EV charging as the curb's use, making it difficult to implement travel lane networks or convert the space to another use in the future.
- New technologies may mean it's easier or more efficient to charge an EV at a dedicated station in the near future.

Solutions

- Off-street EV charging can be placed in existing parking garages, lots, superhubs, and at gas stations to keep public space for the public. Especially as charging times continue to decrease, this solution will become more viable.
- EVs are a key part of our green transition and many cities have made ambitious commitments towards electrification. However, cities should keep in mind how curbside EV charging interacts with all other uses of the curb.



Commercial Loading Zones

Access for Goods

Commercial loading zones allow commercial vehicles to deliver goods to businesses, or in the case of online shopping in dense areas, residences. Signage (and sometimes paint) designates the bounds of these zones, and in some cases, providers are charged for their use of a loading zone. Many cities are using technology to create Smart Loading Zones, which go beyond physical infrastructure and enforcement and are discussed later in this report.

Benefits

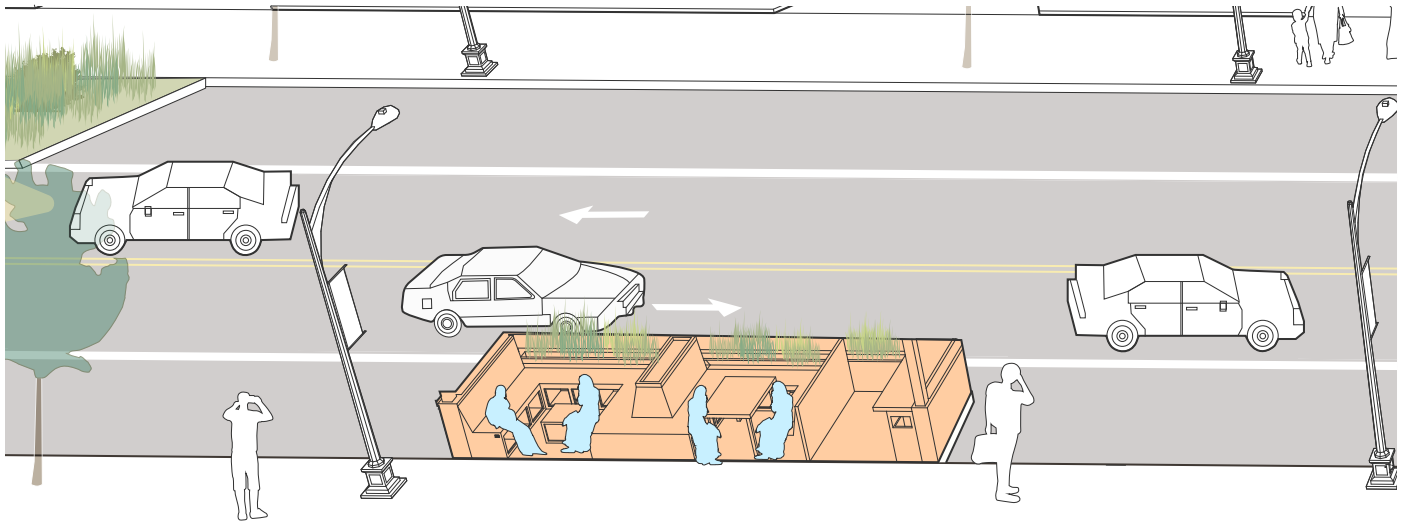
- Providing places for commercial vehicles to load decreases the likelihood that they will be forced to double park, idle in travel lanes, or block sidewalks and crosswalks.
- Designated space ensures drivers are able to efficiently deliver their goods, meaning less time on the road and idling, freeing up road and curb space.

Issues & Conflicts

- If commercial loading zones aren't enforced, vehicles will likely illegally park in them, making them effectively useless.
- Loading zones still may not provide enough space to meet demand in exceptionally dense areas.

Solutions

- Proper enforcement of loading zones, through manual and automatic means, will ensure they are used properly.
- Off-street solutions for freight off-loading and delivery should be explored.
- Moving some deliveries onto micromobility devices will reduce the amount of streetspace needed for deliveries.
- Off-hour deliveries can reduce demand for loading zones during the most busy times of day.



Public Space

Community

Public space can be integrated into the curb lane in a variety of ways including parklets, pedestrianized streets, and providing community groups temporary access to the curb for programming.

Benefits

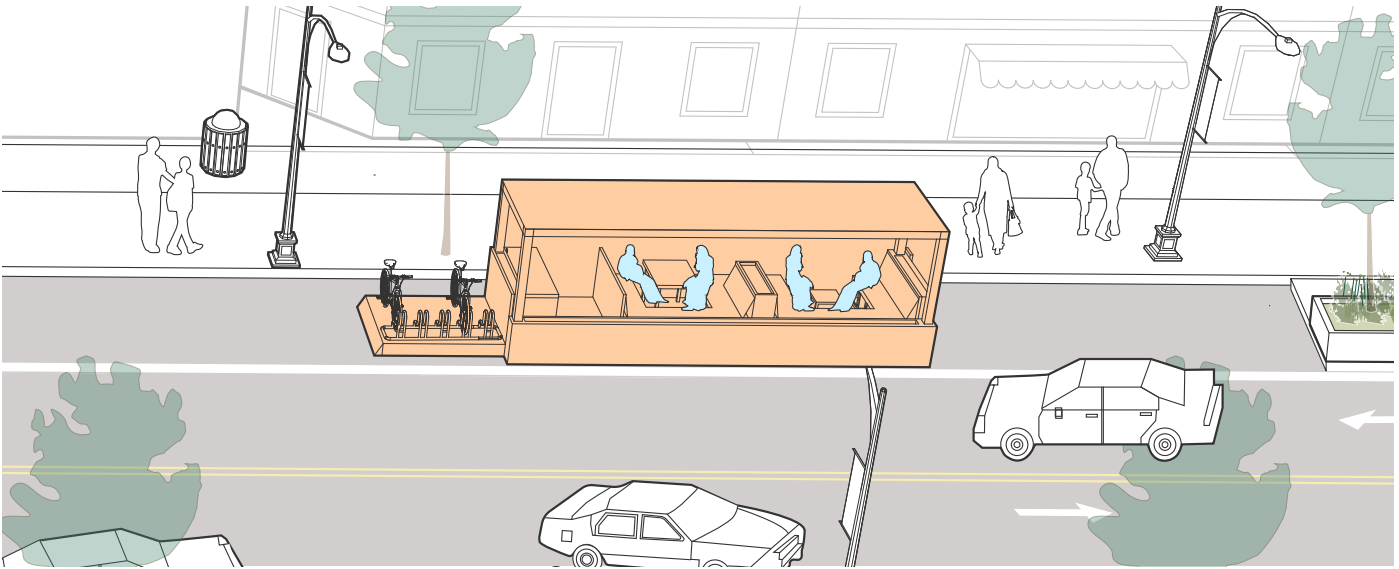
- These types of public spaces give people a much-needed third space to exist in.
- Parklets generate revenue for surrounding businesses.
 - » Studies have shown that they can increase the revenue of nearby businesses by 10% - 20%.¹⁹

Issues & Conflicts

- Maintaining these types of spaces can be expensive and logistically complicated, especially if a city relies on local public space partners to undertake maintenance.

Solutions

- Cities can take on maintenance themselves or provide either monetary or operational support to private partners to provide maintenance.



Curbside Dining

Community

Curbside dining, also called streeteries or Open Restaurants, are open-air dining structures that are placed in the curb lane. Curbside structures are relatively new — popularized by the pandemic — and cities across the country have different permanent and temporary rules and regulations surrounding them.

Benefits

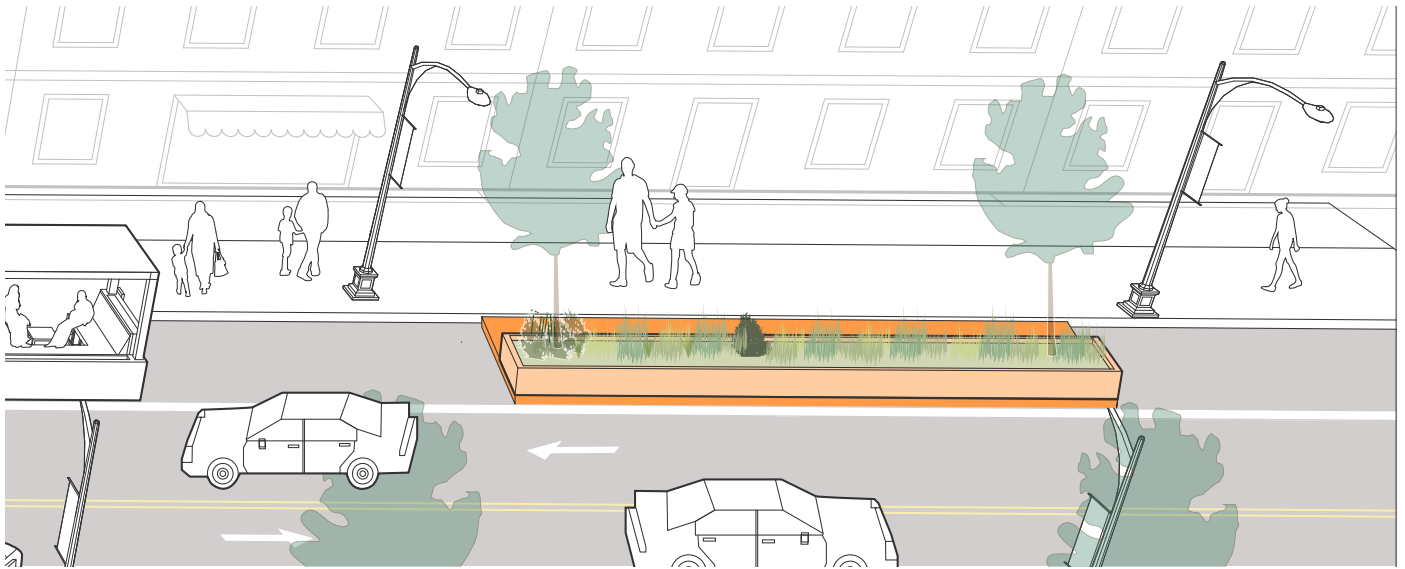
- Access to curbside dining gave restaurants, particularly local restaurants, a lifeline during the pandemic.
- Curbside dining allows dozens to hundreds of people to use a space in a day as opposed to only one or two cars.

Issues & Conflicts

- Without a permanent, standardized program, enforcement can be difficult.
- Without proper enforcement and standards, curbside dining can have negative quality of life impacts.
- Curbside dining is a private use of public space.

Solutions

- Cities should make temporary streetery programs permanent and allow the requisite department to create standardized rules for structures, which in turn help departments properly enforce these rules.
- Restaurants should pay reasonable rates for curb space that are in-line with demand.



Green Space

Community

Green space in the curb can come in many forms, including bioswales and rain gardens. These features make cities more resilient to flooding, attempting to reduce the effects of and fight against climate change.

Benefits

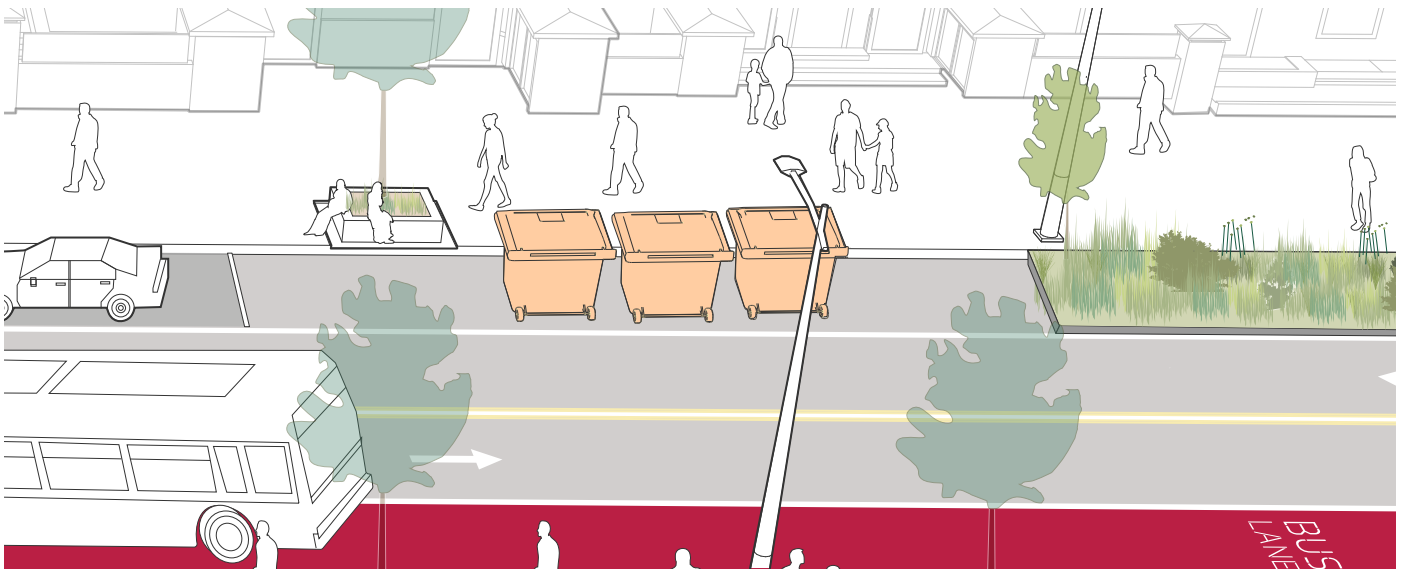
- Having green space, particularly space that mitigates the effects of flooding, helps cities adapt to and fight against climate change.

Issues & Conflicts

- Often, green space requires maintenance that is done by local partners. Not all neighborhoods have the capacity to undertake such maintenance, creating equity issues.

Solutions

- Cities can take on maintenance themselves or provide either monetary or operational support to private partners to provide maintenance.



Containerized Trash

Community

Containerized trash provides blocks with standardized containers meant for storing garbage for pick up. Often located in the curb lane, these containers are designed to prevent trash from piling up on the sidewalk or in the curb.

Benefits

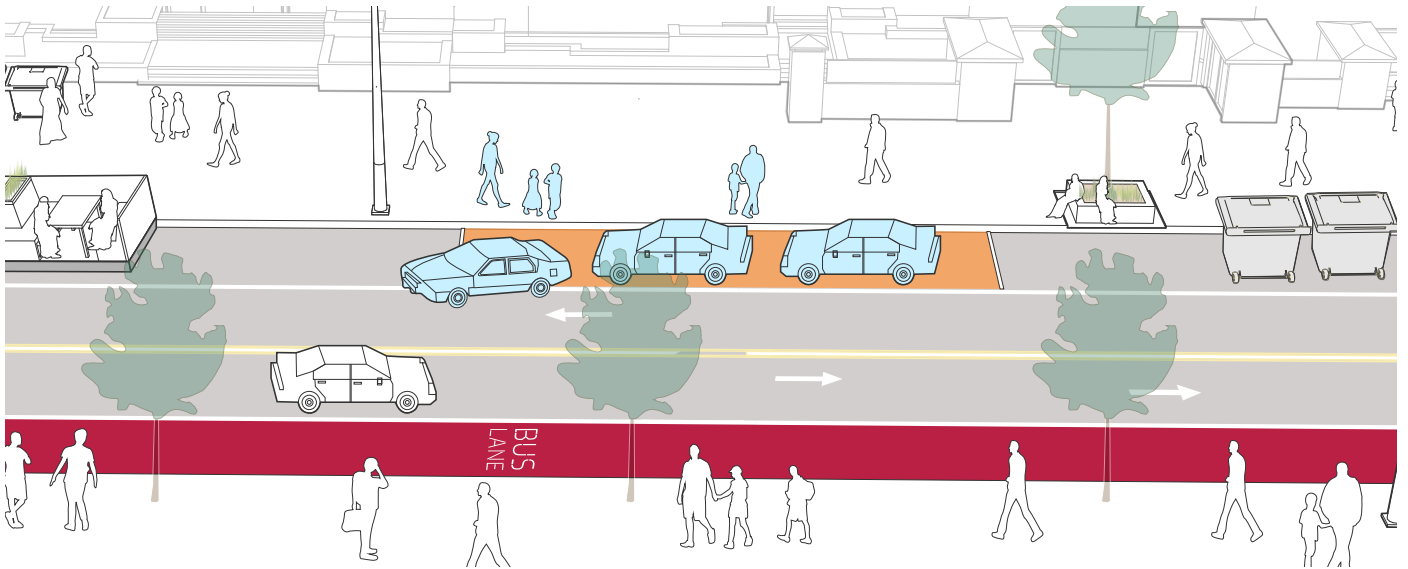
- Placing garbage in standardized, centralized containers frees up sidewalk space from trash bag pile up.
- These containers allow for more efficient and easier trash pick up — typically automatically picked up by the trucks themselves — decongesting streets and shortening trash pick up routes.
- Containerized trash helps prevent litter from falling out of bags and keeps rats at bay.

Issues & Conflicts

- Efficiencies in collection could mean job loss for sanitation workers.
- In dense neighborhoods where buildings generate large amounts of trash, containers may not be able to accommodate all the trash.

Solutions

- Job loss can be mitigated by working with unions and creating other opportunities like oversight of collection or container maintenance.
- More frequent pick ups could help mitigate issues with excess trash.
- New technologies require iteration and investment to ensure that trash pickup is efficient and that bins are maintained.



Free Parking

Storage

Free parking spaces allow private vehicles to be stored on the street for long periods of time.

Benefits

- Free parking provides easy access for residents to store their private vehicles, and therefore, provides them with a mobility option.

Issues & Conflicts

- Free parking, and the car culture that it creates, conflicts with almost every other curb use.

Solutions

- Cities should allocate curb uses according to land use in order to increase efficiency at the curb.

Findings:

Emergent

Themes

in

Curb

Management



During our conversations with practitioners, curb users, and curb technology experts, we identified four common themes in curb management. These themes form the bedrock of sound and effective curb management.



Designating and Actualizing a Curb Lane



Cataloging, Organizing, and Updating Curb Management Policies



Consolidating, Standardizing, and Digitizing Internal Curb Infrastructure, Data, and Regulations



Enacting Effective and Equitable Enforcement Methods



Designating and Actualizing a Curb Lane

The most prevalent and foundational tenet of modern curb management is the recognition that the “parking lane” is used for much more than just parking. It’s a lane used for pick up and drop off, loading, micromobility storage, safety improvements, outdoor dining, and so much more. **The curb lane is public space, and regarding it as merely a place for private vehicle storage impedes the ability to change and improve management strategies at the curb.** Instead, it is better to think of and refer to that space as a “curb lane.”

When speaking with practitioners, there was little preference or import placed on the actual name that would take the place of the “parking lane.” As curb management has grown in silos around the country, different names have been used to replace the “parking lane” — Seattle has flex zones

and some data standards refer to it as a “curb zone.” Both will be discussed later in this report. However, there may be value in moving forward with a unified name across multiple cities. Flex zones, for example, are referred to in some localities more as a “curb lane” while in others, the term means exclusively that curb regulations are “flexible” depending on the time of day. For this reason, unifying around a singular term may be advantageous for intercity coordination.

Part of actualizing a curb lane requires public outreach. Some members of the public may understand and even agree that the curb is and should be used for more than just free parking. However, the purpose of designating the lane as a curb lane is not only to recognize that its uses are diverse, but also to change external and internal perceptions of the curb

By stressing the importance of making full use of the curb in order to better adapt to climate change, induce mode shift, or jumpstart the economy, practitioners can better realize what the curb lane actually is — something that impacts all parts of the way a city operates.



Utilizing green space to daylight intersections achieves two important goals: making our communities more resilient by absorbing flood water while increasing visibility and safety on our streets.



The Union Square Partnership in New York City mobilizes volunteers to create vibrant curb extensions in an exercise of community-building and beautification.

over time. Therefore, public outreach is a crucial step in actualizing a curb lane. This includes public outreach to residents who park at the curb with explanations of how these changes help them — like reductions in congestion, increased curb turnover and therefore parking availability, and expanded availability of public uses.

Practitioners also mentioned the importance of connecting the idea of a curb lane back to other city goals like

climate, transit, and economic plans. Doing so not only rationalizes decisions at the curb generally, but also has the potential to place an internal priority on curb management projects. By stressing the importance of making full use of the curb in order to better adapt to climate change, induce mode shift, or jumpstart the economy, practitioners can better realize what the curb lane actually is — something that impacts all parts of the way a city operates.

Cataloging, Organizing, and Updating Curb Management Policies

Due to the expansive nature of the curb, its regulations and policies are numerous and are often spread among many departments. Because of this, policies can become outdated, regulations can remain inefficient, and planning decisions can bring curb uses into conflict. Therefore, in order to reform the curb, it is vital to catalog and organize existing curb management strategies to ensure cohesion, efficiency, and harmony among policies.

Several cities that were interviewed have teams solely dedicated to curb management, bringing together disparate but related actors in the department towards the goal of better managing the curb. These cities, as well as cities that

do not have such teams, have indicated the usefulness and potential of teams like this. Assembling a team dedicated to curb management can play an important role in organizing existing regulation.

Most leaders in curb management have or are in the process of creating a comprehensive curb management strategy, which serves as a guiding document for how the city operates its curbs. In this document, a city has the opportunity to communicate the diverse uses of the curb as well as their prioritization in various parts of the city. This document can also serve as a roadmap for how to improve and reform current curb management strategies.

However, practitioners noted that curb management strategies are not a one size fits all solution, and that prioritization frameworks and guidelines should not be used blindly in all contexts.

Curb management strategies are useful in leading the city's curb management forward, allowing for more holistic planning rather than just one-off changes. However, practitioners noted that curb management strategies are not a one size fits all solution, and that prioritization frameworks and guidelines should not be used blindly in all contexts. This can lead to unnecessary conflicts between uses — for example, if a bike lane replaces a commercial loading zone without taking into consideration where the loading would occur after the change. Instead, context-specific, block-by-block planning should be used in tandem with overarching goals and objectives outlined in a curb management strategy.

Creating an effective curb management strategy and prioritization framework requires public and stakeholder engagement. Practitioners have noted the importance of public outreach during this process, but have also noted the struggles that come along with it. Conducting an equitable and fulsome public engagement process on complicated curb regulations can be difficult, especially considering those who engage in such processes are typically unrepresentative of the public at large — often wealthier, older, whiter, and more likely to own a car. Therefore, crafting innovative public engagement processes that reach all road users is vital.



A comprehensive curb management strategy facilitates more vibrant and communal uses of the curb rather than reserving it solely for private vehicle storage.



Consolidating, Standardizing, and Digitizing Internal Curb Infrastructure, Data, and Regulations

We heard time and time again from practitioners that in order to know what to change, it's necessary to know what you have. This is true for infrastructure and regulations that shape the curb, as well as the data that defines it. Cities across the country are learning how to leverage these things — like the number of free parking spaces in a city, time of day restrictions in an area, or turnover rates on a block — to improve the efficiency of the curb. Without data, it is difficult to know if curb reallocation strategies in a given city are effective. Like the staff who manage the curb, curb metrics are often strewn throughout different spreadsheets, teams, and departments. Consolidating them into one place — a digital curb inventory — is important.

A key part of digital consolidation — an oftentimes massive undertaking — is utilizing a data standard. **The Curb Data**

Specification (CDS), developed by the Open Mobility Foundation, is an open-source, collaborative data standard that has been adopted by many major cities across the country, including eight recipients of the FY 2022 U.S. Department of Transportation SMART grant.²⁰ Such a widely used standard for curb data can help streamline the consolidation process and lower the barrier to entry for cities interested in expanding their digital infrastructure. CDS is also developed directly in collaboration with cities, which allows them to take an active role in forming the data standard.

A number of companies have cropped up in order to tackle the difficult work of digitizing curbs. However, as practitioners have noted, for some cities the cost of contracting with these companies can be burdensome. Additionally, dealing with companies introduces a number of important questions for cities: how will



Assembling digital curb infrastructure has the potential to better organize and visualize a city's curb regulations and uses, as Omaha, NE's ongoing digital curb project shows.

A digital curb inventory is an important part of managing the curb, but it is not a prerequisite for other reforms.

the city maintain ownership of the data? What format will it be in? How will it be updated? What happens if the company collapses or is shuttered by a new parent company? These questions and the answers to them, like the questions about what methods work at the curb, will vary depending on the city but shared learning will aid the process greatly.

A benefit of creating a digital curb inventory is the opportunity to display this data to the public. As of writing this report, no city has done this at scale citywide. However, a number of cities — ones we spoke to and otherwise — have started towards this goal. There is the opportunity to apply for external grants

and/or partner with companies to create this tool. Such a tool means different things to different cities, and its utility will vary depending on each city's context.

It's important to note, however, that cities should not wait to make improvements to their curb regulations and infrastructure until they have a completed, fully fleshed out digital curb; the two initiatives can happen in parallel. Consolidation is an important first step, and standardization and digitization can happen over time. A digital curb inventory is an important part of managing the curb, but it is not a prerequisite for other reforms.

Enacting Effective and Equitable Enforcement Methods

Unless there is adequate enforcement, many dynamic curb uses become inert. For example, if a commercial loading zone is not enforced by the city or automatically enforced by camera-based technology, it quickly becomes a free parking spot. This creates conflict between curb users, makes the street more disorganized, and defeats the purpose of establishing the loading zone in the first place.

The underlying intent and emphasis placed on expanded enforcement should not be revenue generation, it should be efficiency and safety. Revenue generation by curb

enforcement can be a significant boon to the city, but internally — and especially externally — it should not be the focus. The purpose of enforcement should ultimately be to change user behavior at the curb.

All aspects of curb enforcement are important to its operation. This includes physical infrastructure like signs and paint, which play important roles in ensuring users understand the rules at a given curb. Practitioners highlighted the importance of concise, accurate, and visible signage in enforcing uses like loading zones. A city's parking enforcement agents — whether

Partially and fully automated enforcement like license plate readers, AI-based technology, and other automated enforcement can complement traffic enforcement agents to form a robust enforcement mechanism designed to change behavior.

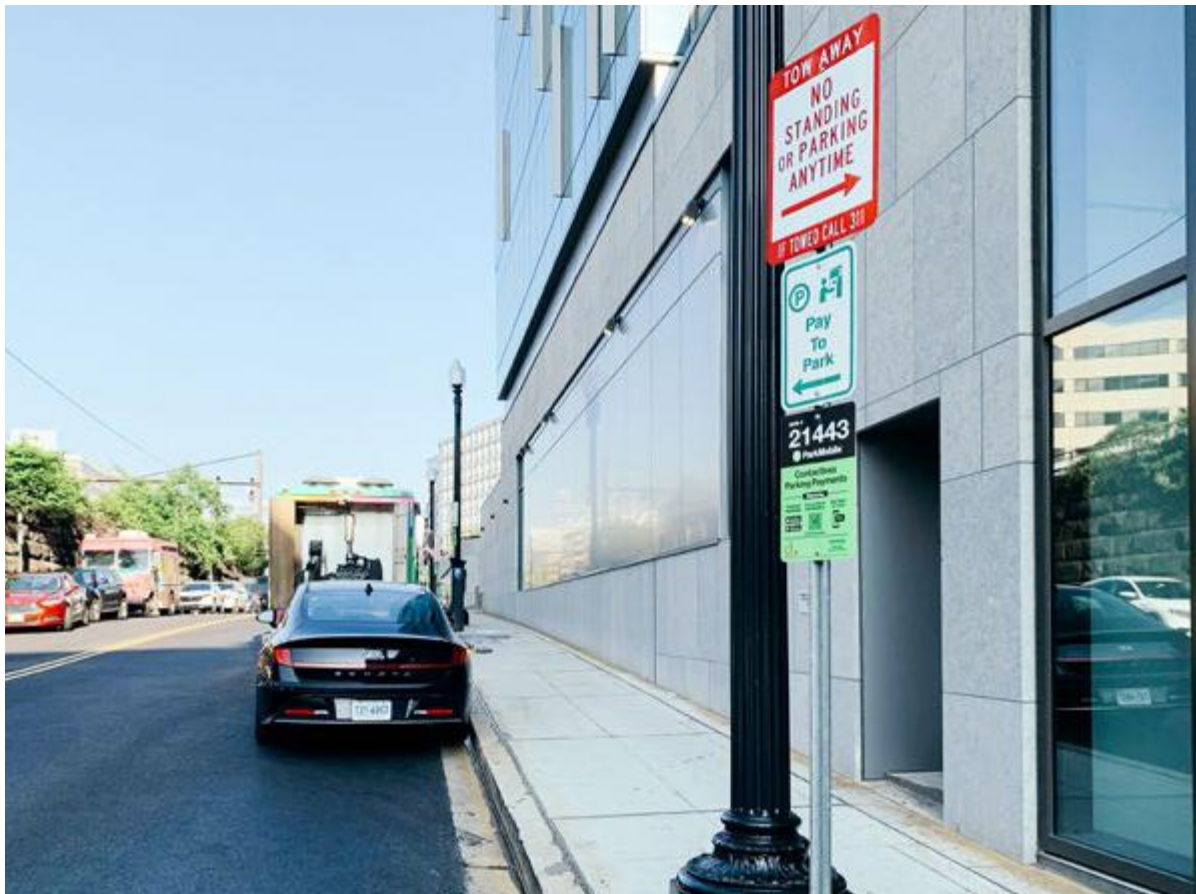
police or another agency — should be empowered to enforce the curb and should make such enforcement a priority. Partially and fully automated enforcement like license plate readers, AI-based technology, and other automated enforcement can complement traffic enforcement agents to form a robust enforcement mechanism designed to change behavior.

Many practitioners identified a number of barriers to implementing automated camera-based enforcement. One foremost among these issues was the need for state authorization in order to proliferate camera-based enforcement; legislative pushes for automated enforcement can be difficult.

Practitioners mentioned two other factors — equity and privacy — when discussing automated enforcement. Practitioners agreed that automated enforcement is the most equitable enforcement method and circumvents many of the biases that exist in current enforcement so long as cameras are located around the city in an equitable way. Privacy remained a concern for practitioners, though many camera-based solutions account for this. Companies often go to great lengths to assure cities that their collection and transmission processes are secure, and that they are collecting information about objects (meaning vehicles) and not individuals. It is rational for cities to be conscious of their residents' privacy concerns, but should not serve as an absolute barrier to adoption of automated enforcement.



Cities have found ways to modernize their curb management and parking enforcement. Washington, D.C., for example, is one of many cities to implement contactless paid parking enforced through license plate recognition.



Findings: Leaders in Curb Management



An aerial, halftone-style photograph of a city street. A prominent red curb lane runs along the right side of the road. The street is lined with buildings and trees, and the overall image has a grainy, dotted texture.

**Seattle, WA: Pioneering the
Idea of a Curb Lane**

**San Francisco, CA: Creating a
Comprehensive Curb Management Strategy**

**Omaha, NE: Building Out Digital
Curb Infrastructure**

**A New Frontier: Promising
Pilots Across the Country**

Seattle, WA: Pioneering the Idea of a Curb Lane

In 2016, Seattle released Seattle 2035, a comprehensive planning document for the city mandated by Washington’s Growth Management Act. Seattle 2035 contains plans for a wide variety of issues including land use, housing, and most relevant to this report, transportation. In their plan, Seattle makes an important distinction between the sidewalks (pedestrian realm), the traffic lane (the travelway for vehicles), and the space in between the two, which they designated the flex zone.²¹

Beyond introducing the concept of the flex zone, Seattle took the next step and outlined what an actualized flex zone

looks like. They developed priorities by land use (Figure 1), with an emphasis on advancing existing transportation and environmental goals. In most areas, long-term parking, rightly defined by Seattle as “storage,” is far from the first priority. Instead, efficiency and accessibility for public transit, active modes of transportation, and the movement/distribution of goods are centered. Uniquely, Seattle highlights the importance of “greening” infrastructure at the curb — features like planters, rain gardens, and bioswales — further instilling city goals into the actualization of the flex zone.

Figure 1: Seattle’s Flex Zone (Curb Lane) Use Hierarchy²²

	Residential	Commercial & Mixed Use	Industrial
1	Support for Modal Plan Priorities	Support for Modal Plan Priorities	Support for Modal Plan Priorities
2	Access for People	Access for Commerce	Access for Commerce
3	Access for Commerce	Access for People	Access for People
4	Greening	Activation	Storage
5	Storage	Greening	Activation
6	Activation	Storage	Greening



Seattle's expansive bus network utilizes the curb in a variety of ways in order to provide access and mobility to people across the city.



This dedicated two-way bike lane allows micromobility users to easily navigate the street safely.



Bus lanes in Seattle help reduce delays, and camera-based automated enforcement ensures that they remain clear.



... “finding a balance’ between different demands” is not sufficient, and that different curb uses must be “systematically prioritize[d]” for different land uses.

Part of the reason that Seattle has been recognized as a leader in the curb management space is their recognition of the curb as a flex zone. The concept of a flex zone has been recommended to cities by the National Association of City Transportation Officials (NACTO), cited by the Institute of Transportation Engineers in their Practitioner’s Guide, and used as an effective case study in reports such as this one.²³

This approach influences the way that Seattle’s Department of Transportation manages their curbs. In their 2019

Curbside Management Report, they make this clear — that “finding a balance’ between different demands” is not sufficient, and that different curb uses must be “systematically prioritize[d]” for different land uses.²⁴ These values are displayed through some of their accomplishments of that year: protected bike lane installations, loading zone expansions, a pilot program for a priced curb, and ongoing community outreach. This expansive view of the curb lane as more than just a parking lane allows for more robust changes to be made at the curb.

Key Takeaways

- The concept of a flex zone allows cities to think about the curb lane beyond the bounds of parking.
- Prioritizing uses at the curb provides an outlet for cities to advance existing priorities (like transportation and climate goals) at the curb. This can be seen through Seattle’s emphasis on their modal plan priorities and greening uses of the curb.
- Viewing long-term private vehicle storage as such, rather than something like access for people, sufficiently highlights the proper relationship between private cars and the curb.
- Including activation within a framework understands the potential that curb space can play in everyday life — as a conduit for community and joy.

San Francisco, CA: Creating a Comprehensive Curb Management Strategy

In 2020, the San Francisco Municipal Transportation Agency (SFMTA) released their Curb Management Strategy, a “roadmap for how the SFMTA will manage and allocate the City’s limited and valuable curb space.”²⁵ The strategy notes the changing use and purpose of the curb, and outlines how San Francisco can better adapt accordingly. Contained within the report are two essential parts of any curb management strategy: a hierarchy at the curb and an exhaustive section dedicated to improving existing and implementing new curb rules, regulations, and policy.

Their curb hierarchy — the most robust in the country thus far — is divided into different land uses and functions of the curb. In the report, SFMTA recognizes that all neighborhoods are unique. This is an essential recognition; generalized land use-based hierarchies can be used as guides, but not strict rules, to prioritize functions of the curb in different areas of the city.

The section devoted to updating and creating new curb strategies is similarly ambitious. There are six main objectives outlined, each with their own sub-objectives and individual recommendations. More than making vague recommendations, SFMTA applied

a required level of effort and potential impact, ranging from low to high, and a timeline, ranging from short to long-term. These factors are important as, in many cases, there are dozens of changes that need to be made at the curb and operationalizing and prioritizing them is key to a good workflow.

Work on the strategy began in 2018, and SFMTA integrated a number of development techniques into the document contributing integrally to the document’s success and utility, including: interviews with staff within SFMTA and other city agencies involved with the curb, an external review of best practices in cities across the country, and data collection at the curb.

Discussing existing policies, pain points, and places for improvement across city agencies is key to envisioning a holistic view of the curb. Interagency collaboration at the curb is essential in reducing conflict and increasing efficiency. Intercity collaboration is likewise important. No one city can pilot all techniques, and each city’s unique aspects may breed innovative techniques. Shared learning and an active dialogue across cities about the curb helps individual cities and furthers the discipline.



In 2020, San Francisco released their comprehensive curb management strategy in order to make the curb more safe, efficient, and joyful for all users.



Collecting data on the curb and cataloging uses across the city was an illustrative process for SFMTA. The results of taking inventory of curb uses revealed that 90% of the curb was used for parking while just 1% was used for active uses like bus stops, bikeshare, and paratransit.²⁶ Through this, it became abundantly clear that the goals of the agency and the realities at the curb were mismatched, which served as rationale for many of the strategy's changes.

The values present in the management strategy were already present in SFMTA's ethos, and the strategy verbalized these values and made them more actionable. The strategy is designed not only to improve curb management generally, but also to aid San Francisco's existing priorities like Vision Zero, Transit First, and their Climate Action Strategy.²⁷ Implementation of the strategy is still ongoing and continued stakeholder and public outreach will remain a priority for SFMTA going forward.

Key Takeaways

- A comprehensive curb management strategy can serve the purpose of cataloging, updating, and advising a city's curb management policies.
- Establishing a curb hierarchy can guide curb management policy actions and goals in a given neighborhood, but should not be used as a rigid rule.
- Recommended policy changes and objectives should have an associated level of effort, impact, and time investment to inform implementation strategies.
- Interagency collaboration at the curb is essential to ensure curb conflicts are avoided and streets are efficient.
- Cataloging curb uses can reveal existing inequities in curb use and inform policy changes.



< A comprehensive curb management strategy allows a variety of uses to thrive, like the personal micromobility storage and parklets pictured.



^ Green space can be implemented into a number of curb uses, including parklets, outdoor dining, micromobility storage, and many more.



^ This dedicated protected bike lane allows micromobility users to easily navigate the street safely.

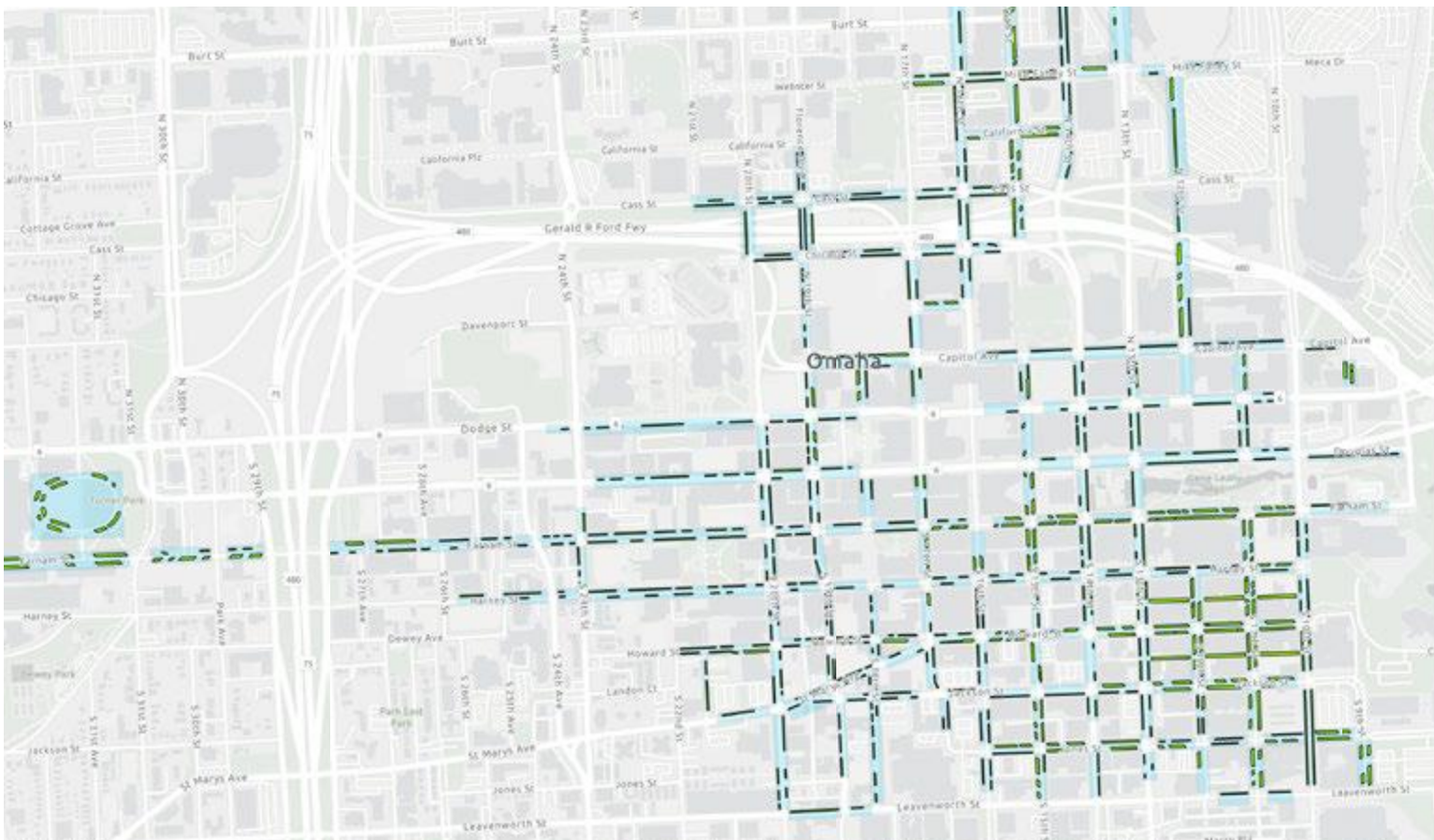
Omaha, NE: Building Out Digital Curb Infrastructure

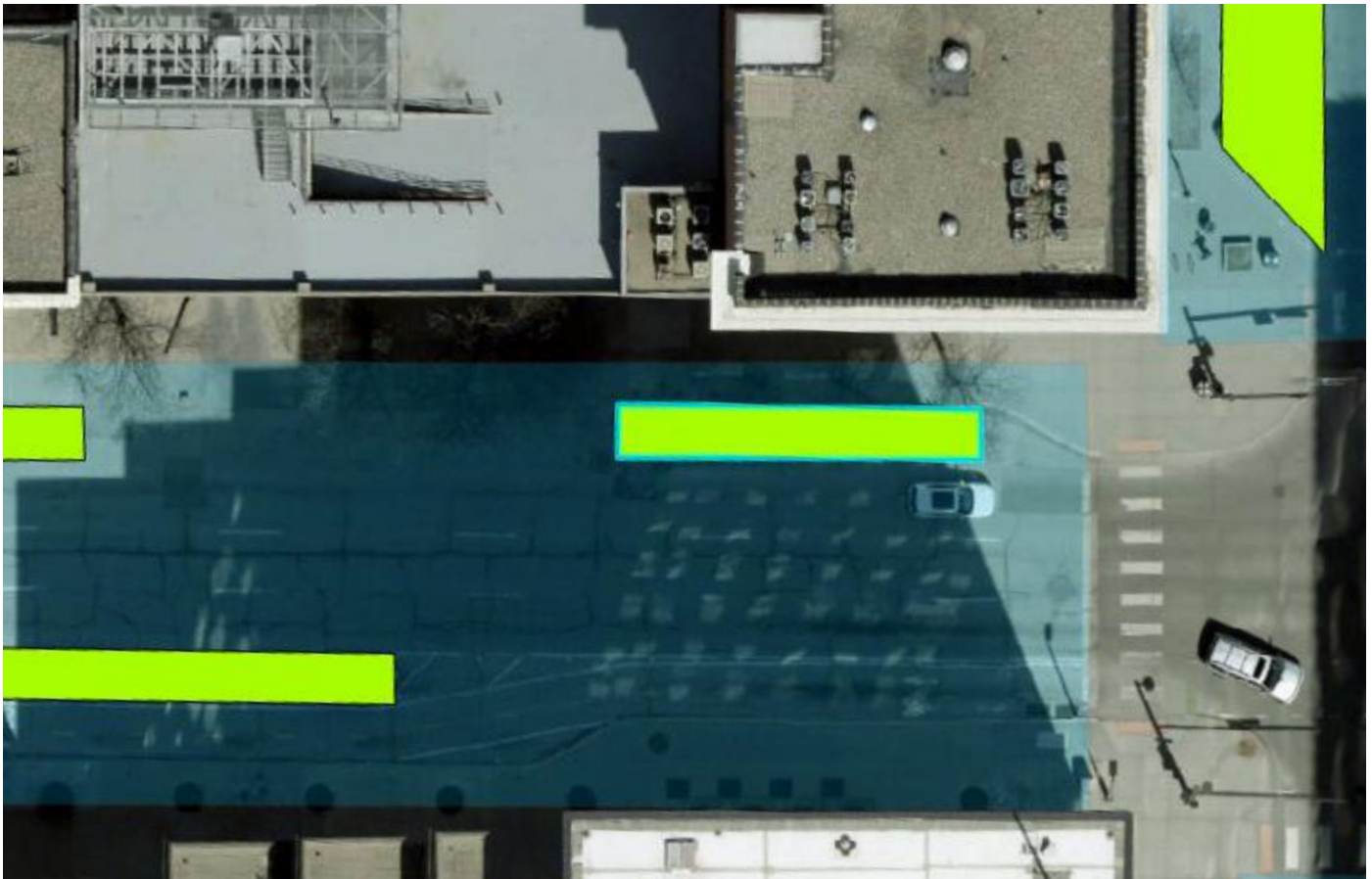
In 2018, Omaha's Parking & Mobility Division made their first steps towards creating a digital curb with an initiative to map the city's downtown and Business Improvement Districts. At this stage, the project's scope was limited to digitizing current linear curb uses like metered parking, loading zones, fire lanes and no parking areas. This initiative began expanding through 2019 and 2020, with staff conducting field visits to verify internal data and create a complete picture of the curb.

At this stage, curb regulations like metered parking and no parking zones were implemented into the database. If physical structures like fire hydrants were observed during field visits, internal georeferencing would be adjusted for accuracy. To reflect the changing nature of the curb, around this time the term "flex zone" was adopted internally to refer to curb zones that changed uses throughout the day. Additionally, the Division undertook a Smart Zone Pilot in 2020 which aided the loading process



Omaha has implemented the Curb Data Specification's curb zones in order to bridge the physical and digital divide.





Omaha's flex zones — stretches of curb that change use depending on the time and/or day — can be easily implemented into the backend of their digital curb.

for delivery and service vehicles while providing the city with robust data on loading zone usage.²⁸

In 2021, the Division expanded their digital curb efforts further. They became a member of the city-led Open Mobility Foundation (OMF), an open-source foundation that works with public and private members to create mobility tools and data standards. OMF stewards the Curb Data Specification (CDS), which gives cities a standardized way to digitally represent their curb and monitor curb activity and metrics; Omaha sits as Co-Chair of OMF's Curb Working Group. Using CDS, Omaha has initiated another curb pilot to create the digital and physical infrastructure (signage) for flex zones.

Converting the existing internal data was straightforward but time-consuming. This

conversion required manual entry as well as multiple steps of internal and external verification using Division data, GIS tools, and field visits. This process took several weeks, but converting the data makes any subsequent changes to the data easier and allows for the opportunity to automate some of the processes. The entire conversion process was illuminating in truly understanding the dynamics of the curb.

There are a number of benefits of building out this digital curb infrastructure. By utilizing CDS, implementing policies like loading zones and mobile payment becomes easier, as does assigning those policy changes to specific curb zones. Additionally, requiring vendors and providers to use CDS as part of an agreement contract decreases friction when intaking data from them and analyzing external data

about activity and curb usage. As of March 2023, all 670 curb zones in Omaha are publicly available, but require preexisting knowledge of APIs and CDS to read and understand. The Division is planning on making a more user-friendly mapped version of the curb zones for public use based directly off of CDS data feeds. They are also engaged in another Smart Zone pilot, which launched in 2023.

At the core of the digital curb project is the goal to make streets safer and more efficient. The process to create the tool as well as the tool itself allows the Division to make better planning decisions that can reduce cruising, dwell times, and conflict at the curb.

Key Takeaways

- Creating a digital curb inventory is an iterative process that can take weeks, months, or years to fully complete, but is worth the time investment.
- Translating existing curb regulations and data into a new data standard like CDS is time-intensive but straightforward, and the conversion allows future changes to be made more easily and efficiently.
- Improved policies and regulations at the curb should not and do not need to wait until a full digital curb inventory is complete; the two initiatives can happen simultaneously.
- A consolidated curb inventory is useful for both internal and external use.
- Ultimately, the goal of a digital curb inventory is to increase the safety and efficiency of a city's curbs and streets.

> Assembling digital curb infrastructure has the potential to better organize and visualize a city's curb regulations and uses, as Omaha, NE's ongoing digital curb project shows.



A New Frontier: Promising Pilots Across the Country

Automated enforcement at the curb is one of the most dynamic parts of the sector. New technologies, methods, and pilots crop up across the country regularly. Understandably, this can make it difficult for cities to determine what technologies work in what ways and in what contexts. Perhaps as a reflection of this, no one city has enacted widespread automated enforcement citywide, but there are a number of promising pilot programs in cities around the country.

One of the most popular types of automated enforcement are cameras geared towards violations in dedicated travel lanes. These technologies can be mounted on street poles, structures, or vehicles and buses themselves. A number of cities, including New York City and San Francisco have piloted these programs to great success. New York City's program has shown to improve bus reliability and speed, increasing the former by up to 36%.²⁹ In San Francisco, the Transit-Only Lane Enforcement (TOLE) program reduced delays by up to 20% in some corridors.³⁰ More importantly, the same study revealed that the TOLE program changed driver behavior. Parking control officers reviewing TOLE footage reported that idling vehicles were more likely to leave bus stops ahead of buses, and just 1% of 2012 TOLE violators received TOLE citations during the study period in 2014.

Automated enforcement in bike lanes is a widely untapped way to increase efficiency, change behavior, improve safety, and raise revenues. A 2023 study analyzed 13 public traffic camera feeds in an attempt to detect parking and idling violations in bike lanes in Manhattan. The study found that, over a 657 day span, there were a total of 5,763 blocked bike lane violations captured on just 13 cameras, a median of roughly 2.7 violations per camera per day. The researchers extrapolated these findings to all of Manhattan, estimating that 2.5 million violations per year occurred in Manhattan and 6.8 million violations per year occurred in all of New York City, totaling \$285 million and \$780 million in lost citation revenue respectively. They also estimated that New York City captures just 1% of all bike lane violations.³¹ While these are estimates in the largest city in the country, they clearly demonstrate the value and importance of proactive automated enforcement in bike lanes.

Another way to automatically enforce curb regulations is through Smart Loading Zones (SLZ). While the exact specifics of what a SLZ entails depends on the specific program, generally they can include seamless digital payment and the ability to schedule load times. Some cities pair SLZ programs with camera-based technologies to enforce illegal



AI-powered automated enforcement has the capability to learn as it observes the streetscape in order to better identify violations like a vehicle illegally occupying a bus lane.

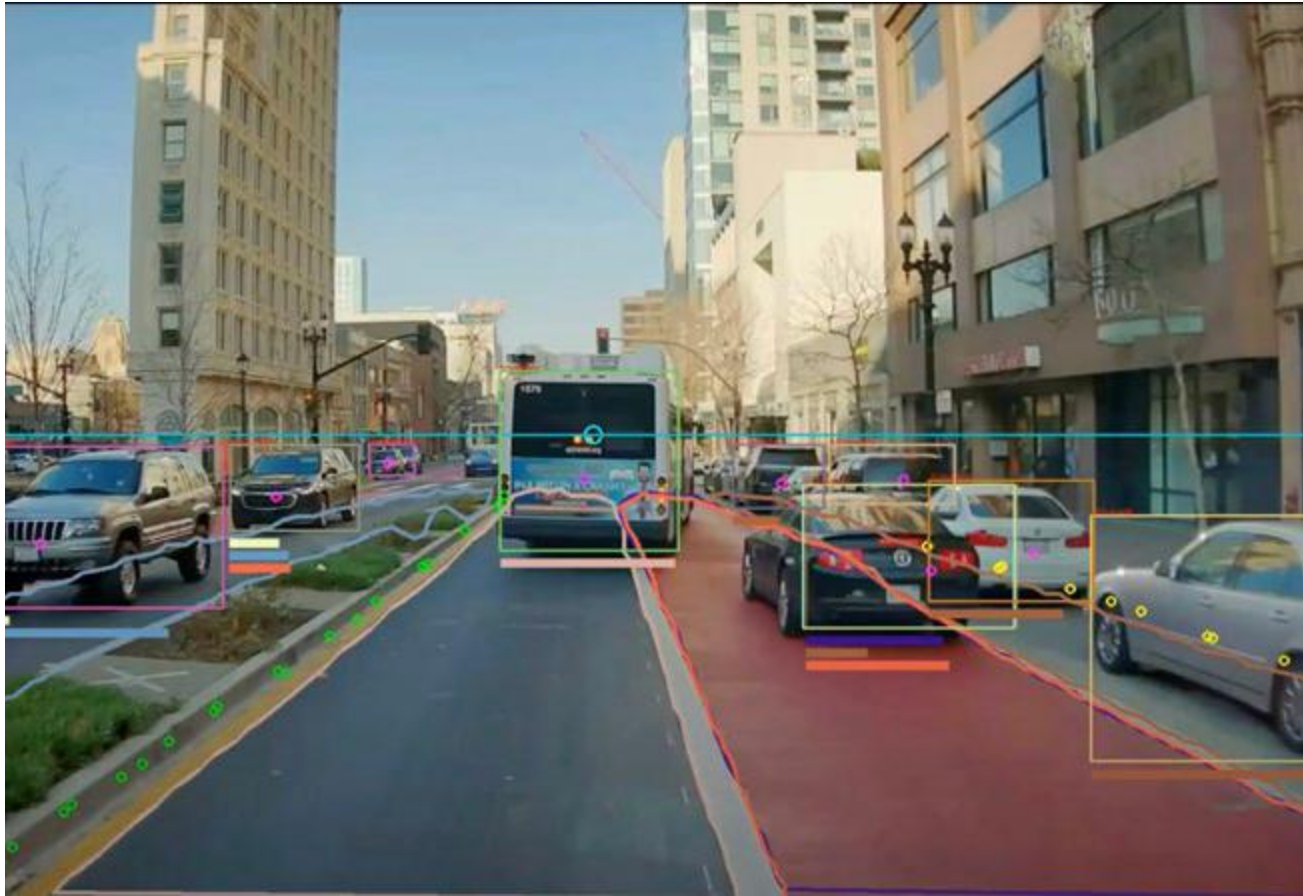
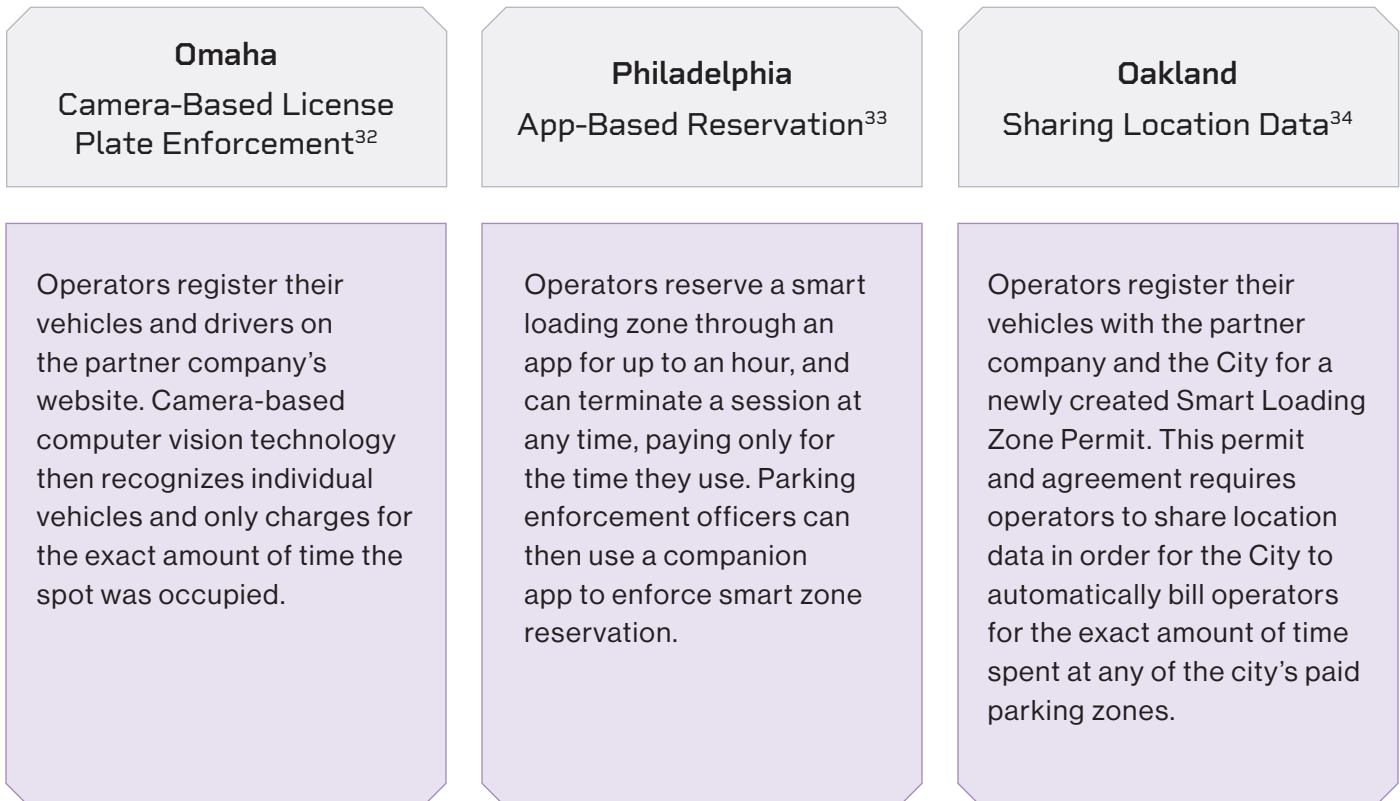


Figure 2: Smart Loading Zone Pilots Across the Country



The ultimate goal of automated enforcement should be to improve efficiency and change individual driver behavior, not to generate revenue.

parking rules in these loading zones. SLZ pilots are relatively new, most initiating between 2020 and 2023 in cities like Omaha, Philadelphia, and Oakland (Figure 2). These pilots show promise and demonstrate the creative ways in which cities can automate payment and enforcement at the curb to reduce dwell and load times, and make streets more efficient overall.

While these are some of the most common methods of automated enforcement, the future for how we can automatically enforce regulations at the curb is limitless. However, the primary barrier to city-level automatic enforcement is pervasive; most cities require state authorization in order to initiate any kind of camera-based enforcement. Promising results from existing and future pilots should be leveraged into more pilots, and eventually, permanent programs.

Key Takeaways

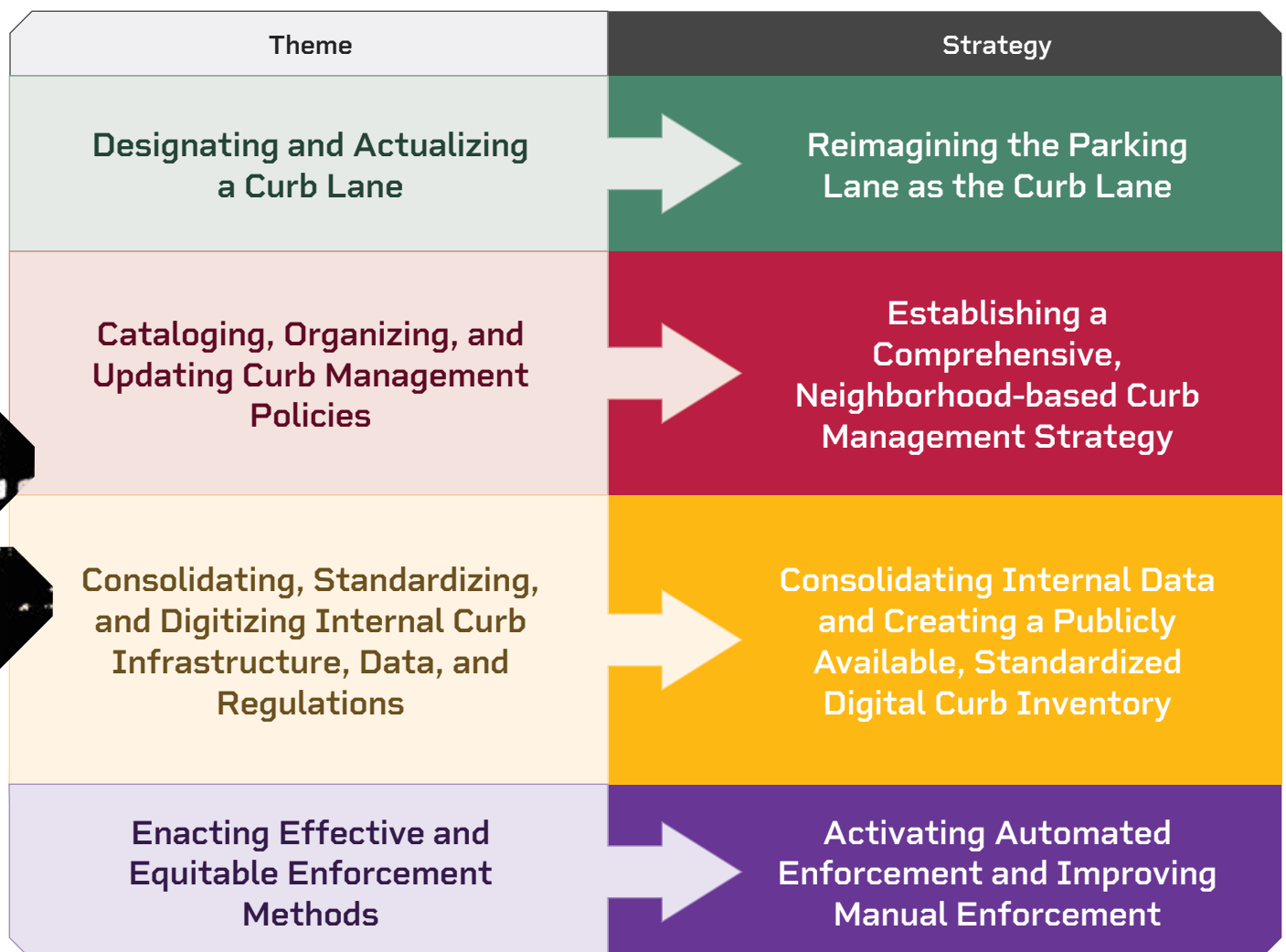
- Automated enforcement in the travel lane has been shown to be effective at reducing delays for buses and changing individual driver behavior.
- Smart Loading Zone pilots are promising and have the potential to reduce dwell and load times, and to improve the flow of our streets.
- State-level authorization remains a barrier for some cities to enact automated enforcement at-scale.
- The ultimate goal of automated enforcement should be to improve efficiency and change individual driver behavior, not to generate revenue.

1) Recomm



Recommendations

Based on our interviews with practitioners, curb users, and curb technology companies, we have assembled recommendations for cities to improve their curb management in four key ways. These recommendations are inspired by the four emergent themes in curb management that were present throughout these interviews.



Summary of Strategies

OBJECTIVE 1: Reimagining the Parking Lane as the Curb Lane

	Strategy	Level of Effort	Potential Impact	Timeline
1.1	Officially redefine the parking lane as the curb lane in department regulations	Low	Moderate	Short-Term
1.2	Differentiate between a curb lane and a flex zone	Low	Moderate	Short-Term
1.3	Link the curb lane to existing city initiatives	Moderate	High	Long-Term
1.4	Conduct public outreach to raise awareness about diverse uses of the curb	High	High	Long-Term

OBJECTIVE 2: Establishing a Comprehensive, Neighborhood-Based Curb Management Strategy

2.1	Create a curb management team	Low	High	Short-Term
2.2	Catalog existing uses and regulations to identify places for improvement	High	High	Long-Term
2.3	Specify timeline, level of effort, and potential impact for changes	Low	High	Long-Term
2.4	Establish a citywide curb hierarchy	Moderate	High	Short-Term
2.5	Create neighborhood-level curb management plans	High	High	Long-Term

	Strategy	Level of Effort	Potential Impact	Timeline
2.6	Conduct public, internal, and external stakeholder outreach	High	Moderate	Long-Term
OBJECTIVE 3: Consolidating Internal Data and Creating a Publicly Available, Standardized Digital Curb Inventory				
3.1	Consolidate physical curb uses, regulations, and existing data sets into a digital inventory	High	High	Long-Term
3.2	Convert existing and future data into a standardized format	Moderate	Moderate	Long-Term
3.3	Ensure best practices when working with contractors, vendors, and service providers	Low	High	Long-Term
3.4	Make the digital curb inventory public	Moderate	Moderate	Long-Term
OBJECTIVE 4: Activating Automated Enforcement and Improving Manual Enforcement				
4.1	Conduct ambitious, efficient, and effective pilots	High	High	Long-Term
4.2	Leverage pilots to enact automated enforcement citywide	High	High	Long-Term
4.3	Emphasize efficiency over revenue	Low	Moderate	Long-Term
4.4	Ensure enforcement is equitable	High	High	Long-Term

Reimagining the Parking Lane as the Curb Lane

1

The first step in truly reforming the curb is viewing it as more than just a space for long-term parking. It is a robust space that can do much more than store vehicles. The following recommendations take steps towards reimagining what is commonly considered the parking lane as a curb lane.

1.1 Officially redefine the parking lane as the curb lane in department regulations

Low Effort Moderate Impact Short-Term

The first step in reimagining the parking lane is redefining the way we talk about it. Through administrative action, departments should strike the phrase “parking lane” from any department regulations and replace it with “curb lane.” Additionally, the department should shift away from using the term “parking lane” in internal and external communications (related to Recommendation 1.4). Instead of maintaining a narrow framing and phrasing of the curb, the use of “curb lane” expands the use of the curb beyond just parking.

1.3 Link the curb lane to existing city initiatives

Moderate Effort High Impact Long-Term

Evidence from cities like Seattle has shown that the adoption of a curb lane provides the opportunity to connect priorities at the curb with other city priorities. Viewing the curb lane as more than just a space for parking allows the city to advance initiatives like incentivizing active and public transit use (through uses like dedicated lanes, storage, and access), fighting climate change (through bioswales and planters), and boosting the economy (through streeteries, loading zones, and metered parking). By bridging the gap between city priorities and the curb lane, the focus can be placed on the curb lane’s increased value to the public good as opposed to a diminished entitlement to parking.

1.2 Differentiate between a curb lane and a flex zone

Low Effort Moderate Impact Short-Term

Many cities across the country use the terms flex zone and curb lane, however the two are not interchangeable. In fact, in different municipalities, they are separate (but related) ideas. Departments should be clear in their usage of the two terms.

The most common use of the term flex zone is to describe a segment of the curb that has regulations that change throughout the day. In some cities, though, a flex zone refers to the curb lane generally, regardless of regulations. A clear delineation should be made: the space in between the sidewalk and travel lane is the curb lane, and if regulations change depending on the time of day, that area of the curb lane contains a flex zone. Both terms are useful, but cities should be clear about the definitions of each.

1.4 Conduct public outreach to raise awareness about diverse uses of the curb

High Effort High Impact Long-Term

Internal recognition of the curb lane is important, but the goal of policies at the curb are to change perception, behavior, and realities at the curb. Therefore, it is important to engage the public on the newly-defined curb lane and the uses it can take. This can be done in a multitude of ways, including:

- Conducting workshops and visioning exercises proactively with communities about their curb space
- Undergoing traditional and social media marketing campaigns highlighting the diverse uses at the curb
- Creating a toolkit of curb uses with terminology, explanations, and engaging visuals to share with the public and elected officials
- On-street activations at events with information about curb uses

NYC.1

- Neighborhood Loading Zones should be further expanded across the five boroughs to ensure equal access to loading.
- Site visits and sensor technology should be used to identify where additional commercial loading zones should be placed in key commercial coordinators in order to reduce the amount of dangerous double parking.
- Freight is transforming cities beyond the curb, and solutions to increasing freight movement must involve looking at the entire system. While this report is limited to actions at the curb, New York City should look into a variety of freight solutions on and off the curb to expand our toolbox including off-hour deliveries, cargo bike and micromobility deliveries, and off-street freight and micro delivery hubs.
- Low-income neighborhoods and neighborhoods of color should be prioritized when making safety

improvements like daylighting in order to rectify historically unequal street design.

- Demand-responsive, dynamic pricing should be piloted in a suitable neighborhood, and the feasibility for a more expanded, citywide program should be studied.
- The Department of Transportation education curriculum should include visioning exercises with students to foster understanding and more creative thinking about diverse curb uses.
- The Offices of the Borough Presidents should engage in community learning and visioning sessions to inform the public of the wide array of ways the curb can be used.
- The Department of Transportation should assemble a toolkit of curb terminology, each curb use, and its benefits to send to Community Boards and community groups.



Daylighting intersections makes streets safer by creating better visibility for pedestrians and drivers, and New York City should aim to daylight every one of its intersections.





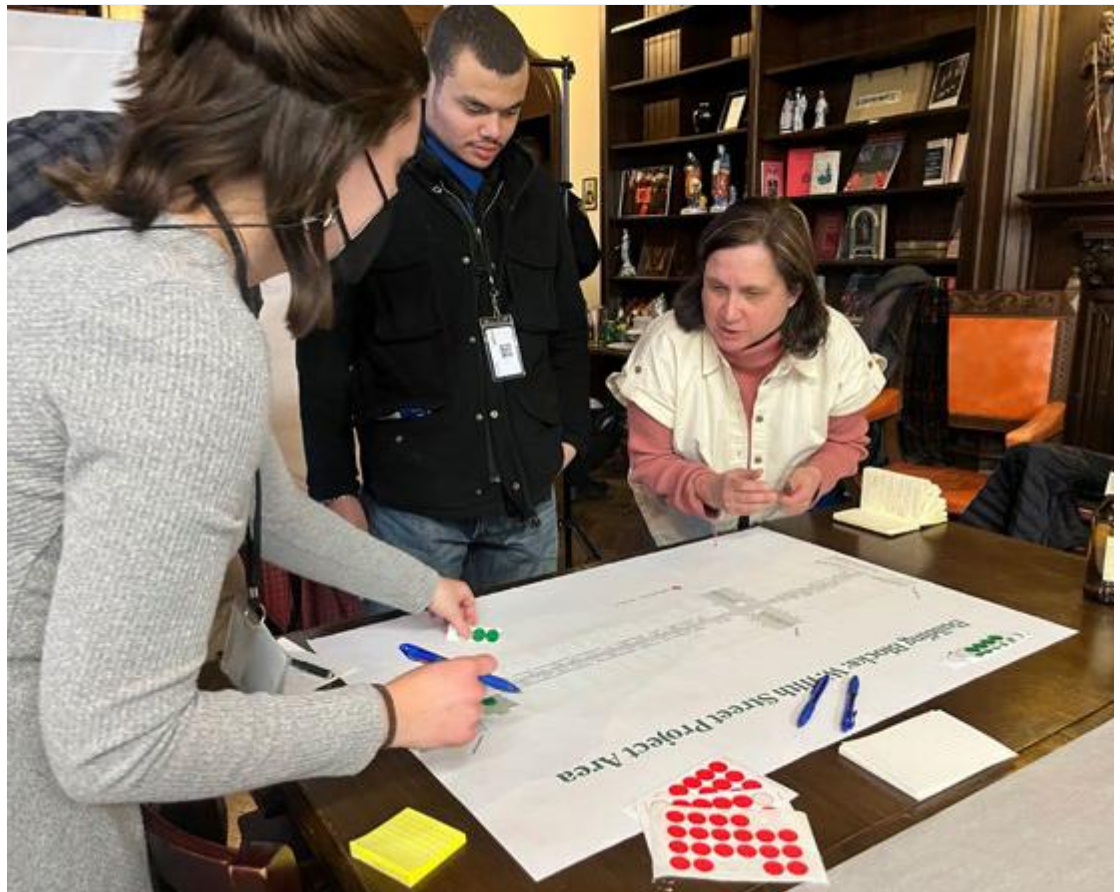
Neighborhood loading zones reduce unnecessary and chaotic double parking, allowing for the easy pick up and drop off of people and goods.



New York City's carshare pilot program has been extremely successful, and provides the mobility of a vehicle to those who may not have the desire or means to own a car.



Public engagement is crucial to making sure that cities understand the needs of residents and are able to emphasize the importance and benefits of changes at their curbs. Communicating with the public should be a key tool in a city's curb management toolbox.



Establishing a Comprehensive, Neighborhood-Based Curb Management Strategy

2

Because the curb is vast, diverse, and dynamic, it is important to have a systematic approach to it and not just make piecemeal policy changes. The following recommendations help ensure that cities look at the entire street ecosystem when making changes at the curb.

2.1

Create a curb management team

Low Effort

High Impact

Short-Term

Cities that are leading in the realm of curb management often have teams or divisions dedicated solely to curb management. This team can be stitched together by shifting around existing staff or created from the ground up. Such a team not only allows the requisite amount of attention to be placed on curb management within departments, but also helps facilitate policy between teams and agencies. Having an individual or team serving as the point of contact to connect the curb between the disparate departments and agencies that it affects helps ensure comprehensive planning.

2.3

Specify timeline, level of effort, and potential impact for changes

Low Effort

High Impact

Long-Term

When creating a curb management strategy, it is important to ensure that it is actionable. In San Francisco's Curb Management Strategy, changes were given a level of effort required to complete, the potential impact of the change, and the timeline associated with it. These are good metrics to follow, especially when coming from a department itself, as it transitions recommendations from being just a goal to being an actionable, tangible step towards improving curb management.

2.2

Catalog existing uses and regulations and identify places for improvement

High Effort

High Impact

Long-Term

Evidence has shown that when cities take holistic looks at their curb, underlying dynamics of the curb are unveiled. This includes taking a catalog of curb uses that exist within a city, their relative proportion to other uses, the regulations that govern each of these uses, and how to improve each of them. Although seemingly self-evident, this process has been illuminating for cities; curb uses, rules, and regulations can span teams, departments, and agencies, and viewing them comprehensively allows for greater understanding of the curb.

2.4

Establish a citywide curb hierarchy

Moderate Effort

High Impact

Short-Term

Setting general guidelines of how to prioritize the curb around the city is advantageous. A hierarchy serves as basic guiding principles for how curb uses should be prioritized, and provides an outlet to specifically note that long-term free car storage is not a priority of the city. Further, when making changes to existing curbs, a hierarchy provides something that the department can point back to as rationale for changes. Cities that have implemented hierarchies commonly use land use types to organize priorities. However, as outlined in Recommendation 2.5, local contexts should be heavily considered when making curb changes as well.

2.5 Create neighborhood-level curb management plans

High Effort High Impact Long-Term

When thinking about effective curb management, it's important to understand that every block is different, and the needs of every neighborhood are different. In order to account for that, each neighborhood should have its own dedicated curb management plan that outlines the current conditions in the neighborhood, how to align the neighborhood's and city's needs, and the solutions and barriers to enact that change. A curb management strategy should not be applied as a cudgel, and departments should be aware of the contextual needs of the neighborhood while maintaining focus on city priorities.

2.6 Conduct public, internal, and external stakeholder outreach

High Effort Moderate Impact Long-Term

An informative outreach process to the public, stakeholders, and city departments that use the curb is vital to understanding how it should be used. Hearing from stakeholders and the public about how they use the curb and the struggles they face can and should inform a curb management strategy, as should how other teams and departments within a city government interact with the curb.

NYC.2

- The Department of Transportation should create a dedicated team and division solely for curb management.
- New York City should craft a comprehensive curb management strategy, which has the following:
 - » An equitable land use-based hierarchy, like the one proposed in Figure 3
 - » A unique curb management strategy for each neighborhood, delineated by their Community Board District
 - » A focus on equity to ensure that the current status-quo of wealthy, white communities as the beneficiaries of curb management pilots and program expansions ends

Figure 3: Suggested Curb Use Hierarchy for New York City

	Residential	Commercial & Mixed Use	Industrial
1	Streets Plan Mobility Priorities	Streets Plan Mobility Priorities	Streets Plan Mobility Priorities
2	Access for People	Access for Goods	Access for Goods
3	Community	Access for People	Access for People
4	Access for Goods	Community	Storage
5	Storage	Storage	Community



As free storage for private vehicles is deprioritized and the curb lane is viewed in a comprehensive way, the curb lane unlocks further potential to facilitate diverse, joyful, and unique uses as shown in these images from Montreal.



Consolidating Internal Data and Creating a Publicly Available, Standardized Digital Curb Inventory

3

In order to make effective changes, it's vital for cities to actually know what's going on at the curb. The following recommendations orient cities towards modernizing their curb using data consolidation, digitization, and implementing innovative curb technologies.

3.1 Consolidate physical curb uses, regulations, and existing data sets into a digital inventory

High Effort	High Impact	Long-Term
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Different aspects of the curb can often be disparate and the internal data that tracks them can be disorganized and outdated. Therefore, it is important to compile, update, and consolidate these aspects digitally. By crossing the physical-to-digital divide at the curb, a city is able to better understand their curb and lay the groundwork for strong digital curb infrastructure.

3.3 Ensure best practices when working with contractors, vendors, and service providers

Low Effort	High Impact	Long-Term
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When working with vendors to manage or monitor a physical curb, or to help create a digital one, cities need to know what data best practices are. First and foremost, after deciding to use a data standard, the city should require vendors that deliver curb data to utilize that standard. The city should also ensure that it maintains ownership over the data, even in the event that the vendor no longer is in operation.

3.2 Convert existing and future data into a standardized data format

Moderate Effort	Moderate Impact	Long-Term
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When deciding to undertake the task of creating a digital curb inventory, it's extremely important to standardize existing data, as well as to ensure future internal and external data is in a standardized format (further described in Recommendation 3.3). Currently, numerous cities, including some of the largest in the country and foremost leaders in curb management, use the Open Mobility Foundation's Curb Data Specification. Maintaining data in a standardized format allows some internal curb data changes to be automated, encourages collaboration with cities that use the same standard, and makes it easier to receive and digest information from vendors.

3.4 Make the digital curb inventory public

Moderate Effort	Moderate Impact	Long-Term
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Once the data is compiled, standardized, and stable, it should be made public. For too long, data at the curb has been opaque, and in order for advocacy groups, elected officials, and other agencies to understand and advocate for a diverse set of curb uses, curb data should be transparent. This inventory should be mapped geospatially, and should be digestible for the public. Similar to how many cities have developed a dashboard for micromobility metrics, such a dashboard should be created with curb metrics (made easier by using a CDS).

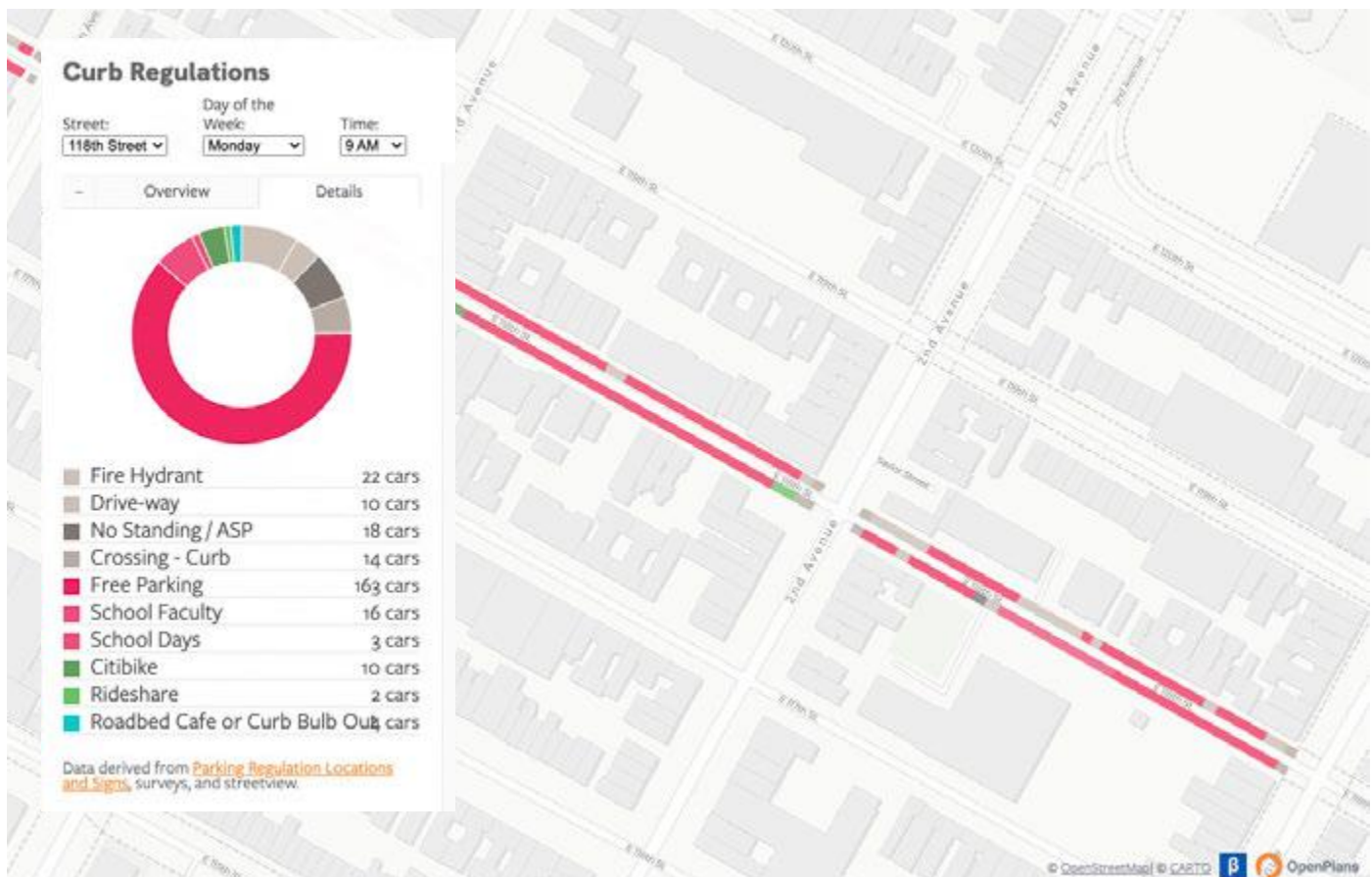
NYC.3

- New York City should create a digital curb inventory with the final goal of making it a public resource for internal and external use.
- Sensor-based technology should be better utilized to collect data to analyze and inform policy changes at the curb.
- The Department of Transportation should actively join in the creation and implementation of the Open Mobility Foundation's Curb Data Specification to ensure it meets the needs of the city.
- The City should publish their curb geographies and policy rules using CDS' public Curbs API feed for all curb users and fleet operators to easily use.
- The City should include contractual requirements to use the Curb Data Specification with all curb contractors, vendors, and service operators.

Open Plans has partnered with BetaNYC to make an interactive digital curb sample.

Our sample displays two streets in New York City — one residential and one commercial — along with their regulations and uses in a user-friendly way. This is accompanied by a pie chart breaking down how the curb lane is allocated, a feature which has the potential to give cities and users a better picture of how their curb is actualized.

You can view the sample and read more here: openplans.org/digital-curb-sample



Activating Automated Enforcement and Improving Manual Enforcement

4

Without adequate enforcement, so many curb uses become little more than de facto free parking spots. The following recommendations act as a roadmap for how cities can improve their enforcement — leveraging automated and manual methods — to enforce their curbs.

4.1 Conduct ambitious, efficient, and effective pilots

High Effort	High Impact	Long-Term
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Pilots are a great tool for departments to test their capacity on a given initiative, introduce it to the public, and prove its effectiveness. Many of the most successful automated enforcement programs (speed and red light cameras) are still technically pilots. Numerous cities have undertaken ambitious and successful pilot programs for smart loading zones and automated travel lane enforcement, and these previous pilots can provide a basis for requesting resources and/or authorization to undertake one.

4.2 Leverage pilots to enact automated enforcement citywide

High Effort	High Impact	Long-Term
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Cities should ultimately leverage the results from successful pilots into citywide initiatives. By working alongside advocates and elected officials, departments should work to expand successful small-scale pilots into larger ones, and expand from there into permanent citywide programs.

4.3 Emphasize efficiency over revenue

Low Effort	Moderate Impact	Long-Term
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When expanding automated enforcement, it's important to ensure that the focus is placed on efficiency rather than revenue generation. While automated enforcement can be an effective revenue tool, its ultimate goal should be to change individual behavior and make streets more efficient; a good enforcement program yields few tickets. Not only is this best practice internally, but making this clear to the public may help quell some concerns.

4.4 Ensure enforcement is equitable

High Effort	High Impact	Long-Term
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Automated enforcement (camera-based and AI-powered technologies) is one of the ways that cities can equitably enforce traffic laws. However, it's important that these cameras be placed in an equitable manner and are not placed disproportionately in low-income neighborhoods or neighborhoods of color. Additionally, manual enforcement (meaning enforcement agents on the ground and those using semi-automated technology like license plate readers) must not exacerbate existing racial inequities. Ideally, individuals enforcing traffic laws should be separate from the police force, under the Department of Transportation or local equivalent, and deployed equitably throughout the city.

NYC.4

- The City should participate in more innovative automated enforcement technology pilots, including deploying camera-based enforcement for a variety of curb uses, (which requires state authorization as mentioned below).
- The City should pilot smart loading zones utilizing the best features of those highlighted in the “New Frontier” case study.
- The City should continue to advocate for necessary state-level legislation to authorize automated enforcement — including a bike lane pilot (S3304/A4637) and a bill that would grant home-rule for all automated enforcement at the curb — and the State Legislature should pass those bills.
- In order to ensure equity of enforcement, the City should consider moving curb enforcement to the Department of Transportation with proper staffing and funding. In the meantime, the City should ensure that the NYPD enforces curb regulations equitably, including on themselves.
- The City should be mindful of all enforcement in low-income neighborhoods and neighborhoods of color that have been over-policed for decades; automated enforcement can help remedy this disproportionate burden but only if placement is equitable.



New York City's automated bus lane enforcement pilot was massively successful in reducing delays and speeding up buses, and other cities can learn from its successes.

Interviewees

Practitioner Interviews

Bend Transportation & Mobility Department

Tobias Marx — Parking Services Division Manager

Boston Transportation Department & Boston

Mayor's Office of New Urban Mechanics

Kristopher Carter — Chair, Mayor's Office of New Urban Mechanics

Matt Warfield — New Mobility Planner

District Department of Transportation

Haley Peckett — Associate Director, Curbside Management Division

Hoboken Department of Transportation and Parking

Gregory Francese — Transportation Planner

Ryan Sharp — Director, Transportation and Parking

Jersey City Department of Infrastructure

Elias Guseman — Senior Transportation Planner

Michael Manzella — Director, Division of Transportation Planning

Lyndsey Scofield — Senior Transportation Planner

Minneapolis Public Works Department

Danielle Elkins — Mobility Manager

New York City Department of Transportation

Oakland Department of Transportation

Kerby Olsen — New Mobility Supervisor

Omaha Public Works, Parking, and Mobility Division

Hannah Adeponu — Assistant Parking and Mobility Manager

Jacob Larson — Applications Analyst

Brandon Patocka — Engineering Technician

Providence Public Works Department

Liza Farr — Curbside Administrator

San Francisco Municipal Transportation Agency

Francesca Napolitan — Curb Access Manager

Hank Wilson — Parking Policy and Planning Manager

Seattle Department of Transportation

Brian Hamlin — Curbside Management Strategic Advisor

Mary Catherine Snyder — Parking Strategist

Curb User Interviews

Bike South Brooklyn

John Tomac — Co-Founder & Organizer

Lime

Phil Jones — Senior Director, North U.S.

Meatpacking District Management Association

Evan Sweet — Director of Neighborhood Planning and Operations

New York Lawyers for the Public Interest (NYPLI)

Eman Rimawi-Doster — Former Access-A-Ride Campaign Coordinator and Organizer

Christopher Schuyler — Senior Staff Attorney, Disability Justice Program

Additionally, NYPLI polled a number of those in the disability community on their experiences at the curb.

Prospect Heights Neighborhood Development Council

Saskia Haegens — Vanderbilt & Underhill Open Streets Organizer

Trucking Association of New York (TANY)

Zach Miller — Director of Metro Region Operations
Additionally, a focus group was conducted by TANY regarding operators' experiences at the curb.

Uber

Josh Gold — Senior Director, Public Policy & Communications

UPS

Axel Carrión — Vice President State Government & Public Affairs

Zipcar

Torrey A. Fishman — Manager, Public Partnerships and Policy
Will Sowers — Senior Manager, Public Partnerships and Policy

Curb Management Technology Interviews

Automotus

Jordan Justus — Co-Founder and CEO
Kelly Schmandt Ferguson — Chief of Staff

INRIX

Ahmed Darrat — General Manager, Public Sector Products

Hayden AI

Jenna Fortunati — Marketing and Communications Manager
Dan Katz — Vice President of Public Policy
Renee Autumn Ray — Senior Director of Global Strategy

Populus

Marla Westervelt — Principal Planner

Vade

Matty Schaefer — Co-Founder and CEO

The individuals listed above generously provided their professional insights and experiences during the creation of this report. Appearance on this list does not necessarily indicate endorsement of any or all recommendations herein. Interviewees are ordered alphabetically.

Acknowledgments

In addition to all of our interviewees, we would like to specifically thank Hank Wilson, Jacob Larson, and the Open Mobility Foundation for providing their insights during the writing of this report. We would also like to thank those who contributed crucial assets to this report: Ruju Joshi for designing the renderings on the curb present on pages 16-33, and Zhi Keng He of BetaNYC for developing the digital curb sample.

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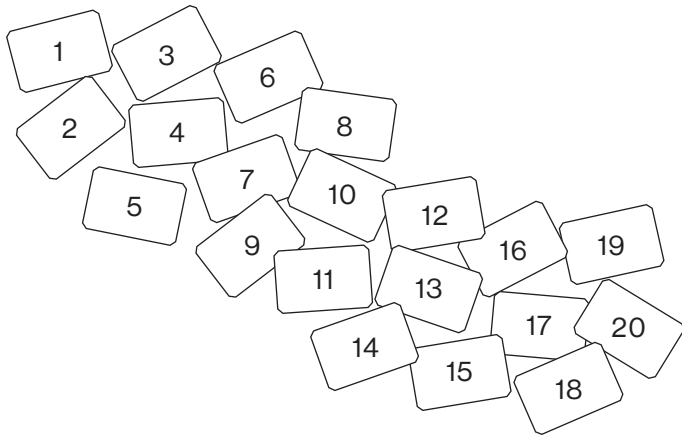
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