



CITYLAB INSIGHTS

The State of Play: Connected Mobility + U.S. Cities

How next generation transportation is shaping cities

BY GREG LINDSAY
JULY 2018

What's Inside

01 About	3
02 Introduction	4
03 Trends and Incumbents	5
Electric Vehicles	5
Autonomous Vehicles	7
Micromobility	9
Autonomous Services	11
Mobility-as-a-Service	13
04 Cities	15
Seattle	15
Columbus	16
Nashville	17
Washington, D.C.	18
05 Scenarios	20
06 Conclusion	21



01 | ABOUT

CityLab Insights

Incubated at CityLab, CityLab Insights has the mission of helping urban decision-makers to make smart, informed decisions that benefit cities today and tomorrow. CityLab Insights' work is independent of any sponsor or funder and is independent of CityLab's journalism. Our work is solely the result of our internal research and analysis. Our goal is to help urban policymakers, private sector leaders, and community advocates navigate the quickly evolving world of the 21st century.

About the Author

Greg Lindsay is a senior fellow at NewCities and Director of strategy of its new mobility festival, [LA CoMotion](#). He is also a nonresident senior fellow of the Atlantic Council's [Foresight, Strategy, and Risks Initiative](#), and a visiting scholar at New York University's [Rudin Center for Transportation Policy & Management](#). He consulted on "Autonomous Vehicles: Future Scenarios," presented by the National League of Cities with support from the Bloomberg Aspen Initiative on Cities and Autonomous Vehicles.



02 | INTRODUCTION

Intro

When it comes to the future of urban mobility, things will get weirder before they get better. For months, you couldn't step outside in San Francisco without tripping over a stray bicycle or scooter, but robots were pre-emptively banned from sidewalks. Uber's new CEO wants to run your city's buses—or at least sell passes through its app, capturing your customers—at a time when ridership is plummeting nationwide.¹ And if selling suburban Sun Belt residents on transit wasn't hard enough already, what happens when the Koch brothers fight back with #FakeNews?²

We're here to help. As the first in a series of CityLab Insights, this paper is designed as a short primer to the state of play in connected mobility. Aimed at public officials and transport professionals, it summarizes current trends, raises questions, and identifies challenges and opportunities in the near- to mid-term.

The first section examines electric and autonomous vehicles, "micromobility," (e.g., bicycles and electric scooters) autonomous services, and the emerging field of mobility-as-a-service (i.e., seamless multimodality on demand). This is followed by snapshots of four cities grappling with the issues these raise: Seattle, Nashville, Columbus, and Washington, D.C. Finally, it poses three futuristic scenarios by extrapolating from present trends: autonomous micromobility triumphant, solar-powered exurbia, and transit's collapse and privatization.

More than a guide to the latest buzzwords, this paper starts from the kind of cities we want—safe, accessible, equitable, livable—and asks how technologies will help or hurt in achieving these goals.

¹ <https://www.citylab.com/transportation/2018/05/the-stark-and-hopeful-facts-about-bus-ridership/559400/>

² <https://www.nytimes.com/2018/06/19/climate/koch-brothers-public-transit.html>



03 | TRENDS AND INCUMBENTS

Electric Vehicles

There's a reason Wall Street hangs on Tesla Motors' CEO Elon Musk's every tweet: For all intents and purposes, Tesla is the U.S. electric vehicle market. Through the first six months of 2018, the Tesla Model 3 sedan was America's best-selling EV, well ahead of the Toyota Prius and triple the sales of the Chevy Bolt.³ Tesla holds three of the top four spots, and given the Model 3's 450,000 outstanding reservations (minus cancellations), it's no wonder why all eyes are on whether Musk can deliver enough cars before either running out of cash or borrowing more of it.

Beyond Tesla, the numbers aren't encouraging. Sales of the pure electric Nissan LEAF and BMW i3 lag far behind the competition, while some models by Volkswagen, Honda, and Ford have sold only a few hundred units in 2018 to date. The federal \$7,500 electric vehicle credit survived GOP tax reform, but will expire soon for Tesla and General Motors.⁴ The Trump administration's hostility to renewable energy subsidies, coupled with its willingness to relax fuel efficiency and emissions standards, will put further pressure on sales. Tellingly, automakers such as GM and Ford are

simultaneously doubling down on light-duty trucks, crossovers, and SUVs while preparing to bring a raft of new EVs to the market between now and 2023.

The latter is driven in large part by China's stringent air quality measures, which has forced global automakers to aggressively pursue electrification to retain access

While American consumers have shunned EVs in the absence of skyrocketing oil prices or draconian measures, technology companies such as GM, Ford, Uber and Waymo have embraced them as the backbone of their future autonomous ride-hailing fleets.

to their fastest-growing market. Volkswagen Group, for example, intends to invest €15 billion in electric and connected mobility in China alone through 2022. Unencumbered by legacy investments, Chinese automakers are also leaping into the fray. April's Beijing auto show featured 174 EV models—124 of which were developed domestically.⁵ Europe will quickly follow China's lead, with multiple cities and nations banning sales of

gasoline-powered cars circa 2030, and diesel engines well before that.

While American consumers have shunned EVs in the absence of skyrocketing oil prices⁶ or draconian measures, technology companies such as Waymo, Uber, and Lyft have embraced them as the backbone of their future autonomous ride-hailing fleets. In spring 2018,

³ <https://cleantechnica.com/2018/07/09/tesla-model-3-model-x-model-s-1-2-3-in-us-electric-car-sales/>

⁴ <https://www.nytimes.com/2018/01/11/business/electric-vehicles-taxes-tesla-gm.html>

⁵ <https://www.bloomberg.com/news/features/2018-04-23/china-s-carmakers-want-to-dominate-world-s-next-era-of-driving>

⁶ <https://www.wsj.com/articles/oil-costs-how-much-how-the-oil-rally-took-forecasters-by-surprise-1525608000>

Electric Vehicles

Waymo unveiled an autonomous, all-electric Jaguar I-PACE, with plans to purchase 20,000 units by 2022. Two months later, it ordered another 62,000 plug-in hybrid Chrysler Pacifica minivans, which would increase its current fleet by a factor of a hundred.

Given EVs' lower total cost of ownership (TCO)⁷—a measure including lifetime mileage and maintenance—the U.S. may see mainstream EV penetration in the form of high-utilization, on-demand fleet services sooner than individually owned vehicles. This has obvious implications for cities, one being competing, proprietary charging infrastructures with potentially rapid obsolescence. In Europe, Tesla and a pair of automaker-backed consortia—the largest of which is Ionity—are already racing to build fast-charging networks.

Cities should consider working closely with private mobility services to co-locate charging stations for mutual benefit ahead of broader adoption.⁸ In Seattle, for example, BMW's car-sharing service ReachNow has invested \$1.2 million to add 100 fast-chargers around the city, effectively doubling the number of public locations. "They see the value in bringing charging to everyone, and we get to keep our fleet on the road," says ReachNow CEO Steve Banfield.

For cities pursuing electrification as part of a low-carbon or air-pollution reduction strategy, one answer has been electric buses. Los Angeles DOT has pledged to convert its diesel fleet to electric by 2030, and will receive its first 25 e-buses in 2019 as part of a Federal Transit Administration "Low-No" grant.⁹ Proterra, which manufactures the vehicles, estimates they will save LADOT roughly \$1 million per year over their 12-year lifespan.

It's a start, but in order for Los Angeles to achieve its sustainability goal of an 80 percent decrease in greenhouse gases by 2050, the city will need to transition its entire transportation fleet to renewables, according to a May report by Siemens.¹⁰ Doing so would not just double or triple the city's transportation electricity consumption, but increase it by 1,500 percent.



Automaker Commitment to Electrification

Ford
GM
BMW
Daimler

Volvo
Toyota
Renault Group
Volkswagen

⁷ <https://www.sciencedirect.com/science/article/pii/S030626191731526X?via%3Dihub>

⁸ https://www.seattle.gov/Documents/Departments/SDOT/NewMobilityProgram/EVCROW_Program.pdf

⁹ <https://www.transit.dot.gov/funding/grants/lowno>

¹⁰ <https://news.usa.siemens.biz/press-release/los-angeles-infrastructure-projections-findings-released-siemens-urban-development-exp>



03 | TRENDS AND INCUMBENTS

Autonomous Vehicles

Uber's AV program was making up for lost time in March when one of its test vehicles struck and killed a pedestrian in Tempe, Arizona. Only weeks earlier, the state had approved Waymo's permit for a ride-hailing service in adjacent Phoenix. Around that time, Ford announced it would begin delivering Domino's pizzas autonomously in Miami-Dade County.¹¹ AVs appeared ready to make the leap from testing to tentative commercial service.

But cities and states eager to let AVs roam freely suddenly had second thoughts. Uber let its California testing permit lapse and dismantled its Arizona program¹² in the wake of a National Transportation Safety Board report concluding the company had disabled the AV's emergency braking feature.¹³

Cities' reservations didn't last long; by May, a startup named Drive.ai announced plans to begin testing shuttles

in Frisco, Texas, and Waymo's CEO recommitted to launching ride-hailing in 2018. Meanwhile, Ford has expanded its autonomous delivery tests, partnering with Postmates to refine its user-centered service ahead of a 2021 production vehicle. Regulating AV safety is out of cities' hands in any case, and a bill before the U. S. Senate would make it a federal matter. But Uber's crash and Waymo's business model reveal equally pressing concerns for cities when it comes to AVs.

It's incumbent on cities to insist AVs operate safely in a mix of modes and on "complete streets."

One reason Phoenix is a popular test site is the "wide open roads" touted by Arizona Governor Doug Ducey in welcoming Uber to the state—roads more conducive to cars than cyclists or pedestrians. Elaine Herzberg was killed by Uber's AV while crossing an eight-lane street; not coincidentally, Arizona

has the highest rate of pedestrian deaths in the country.¹⁴

It's incumbent on cities to insist AVs operate safely in a mix of modes and on "complete streets." They must



NACTO's Blueprint for Autonomous Urbanism illustrates policy goals, and presents the future oriented around city streets as public spaces.

[Access the Blueprint](#) | [Access Complete Streets Guide](#)

¹¹ <https://www.citylab.com/transportation/2018/02/self-driving-pizza-just-hit-miami/554138/>

¹² <https://arstechnica.com/cars/2018/05/uber-shuts-down-arizona-testing-after-march-self-driving-death/>

¹³ <https://www.citylab.com/transportation/2018/05/behind-the-uber-self-driving-car-crash-a-failure-to-communicate/561230/>

¹⁴ <https://www.azcentral.com/story/news/local/arizona/2018/03/01/arizona-has-highest-rate-pedestrian-deaths-united-states-report-says/383640002/>

Autonomous Vehicles

also resist efforts to deploy AVs in geo-fenced areas in which they are the only mode (for safety reasons), effectively privileging them. The National Association of City Transportation Officials has published guidelines¹⁵ calling for slower traffic speed, more frequent pedestrian crossings, and multi-modal interoperability, all of which may be at odds with private operators' wishes.

Equally important, research suggests that ride-hailing services increase congestion in cities around the country.¹⁶ AVs could make this problem worse. Simulations by the Organization for Economic Cooperation and Development's International Transport Forum suggest autonomous ride-hailing or on-demand shuttles could eliminate 90 percent of ride-sharing fleet vehicles on the road while still increasing vehicle miles traveled, raising fears of highly utilized AVs clogging streets and undermining public transport even if private car use declines.¹⁷

Cities should start considering measures to encourage responsible AV use. One idea is a ban or tax on empty privately-owned vehicles (popularly known as "zombies"); another is congestion pricing or mileage-based user fees, which would complement declining

gas tax revenues due to electrification and more efficient routing. It won't be easy: A 2017 Massachusetts bill [Bill S.1945] requiring AVs to pay 2.5 cents per mile and be zero-emissions¹⁸ faced immediate pushback from technology companies in the state, claiming such a tax would destroy jobs and stall innovation.

The big question is how cities will acquire the data necessary to enforce these regulations — already a major point of contention with ride-hailing companies — along with the technology to implement them. Is it better for cities to invest in incumbent platforms such as E-ZPass, or in built-for-purpose systems including Sidewalk Labs' Coord and Ford's Transportation Mobility Cloud?

"Cities historically collect data for record-keeping; they don't see it as an asset," says Benjamin de la Peña, chief of strategy and innovation at Seattle's Department of Transportation. "Our goal is to create systems that are plug-and-play. It's not about telling companies 'Give us your data,' which runs into problems with competitive information. It's going to be, 'Push us this data through our API.'" But it remains to be seen whether the API will, in fact, belong to Seattle DOT.

¹⁵ <https://nacto.org/publication/bau/>

¹⁶ <https://www.citylab.com/transportation/2017/10/the-ride-hailing-effect-more-cars-more-trips-more-miles/542592/>

¹⁷ https://www.itf-oecd.org/sites/default/files/docs/15cpb_self-drivingcars.pdf

¹⁸ <https://malegislature.gov/Bills/190/S1945>



03 | TRENDS AND INCUMBENTS

Micromobility

The images are striking—mountains of discarded bicycles salvaged from China’s bankrupt dockless bikesharing startups—and held up as evidence of a bubble that refuses to pop. But the (self-reported) numbers¹⁹ tell a different story, including doubling China’s bicycle use in a single year and cutting customers’ number of car trips in half.

Americans won’t tolerate mountains of trashed bicycles, but they don’t have to. San Francisco had roughly 10,000 dockless bikes before capping their numbers, compared to Shanghai’s 1.5 million. Even then, the number of bikesharing trips in America increased 25 percent in 2017. Micromobility is the hottest tech in transportation.

It’s not just bicycles, either. Roughly four categories of micromobility have emerged:

1. Station-based bikesharing
2. Dockless bikesharing
3. Electric dockless bikesharing
4. Electric dockless scooters

For the moment, messy competing systems have created their share of problems for cities, including a glut in desirable areas and a dearth in others, along with the questions of how to charge them and where to put them.

Each company’s fleet may offer more than one type. Lime and Spin, for example, have each moved aggressively into electric scooters to compete with Bird, which has raised \$415 million this year²⁰ (at a \$2 billion valuation) and plans to launch in 50 cities by year’s end.

The appeal of cycling and scooters to cities and startups alike is obvious: Micromobility systems complement each other²¹ while stealing trips from other modes. In Washington, D.C., Capital Bikeshare frequently replaces short bus or train trips.²² When Uber acquired the free-range electric bikesharing start Jump in April 2018 for a reported \$200 million, more than \$13,000 per bicycle, Jump’s CEO noted the average trip length in San Francisco was 2.6 miles. Uber saw the writing on the wall: Moving people from the backseats of SUVs to scooters and bicycles isn’t just good policy, but also a lucrative proposition. Hence Lyft’s subsequent purchase of Motivate—which operates New York’s Citi Bike and other docked systems across America comprising 74 percent of total shared bike trips—for a reported \$250 million.²³

For the moment, messy competing systems have created their share of problems for cities, including a glut in

¹⁹ <https://chinachannel.co/mobike-white-paper-report-released/>

²⁰ <https://techcrunch.com/2018/06/28/bird-has-officially-raised-a-whopping-300m-as-the-scooter-wars-heat-up/>

²¹ <https://medium.com/transit-app/docked-vs-dockless-bikes-five-months-in-a86ac801f4c7>

²² <https://www.citylab.com/transportation/2014/07/the-most-persuasive-evidence-yet-that-bike-share-serves-as-public-transit/375142/>

²³ <https://www.citylab.com/transportation/2018/07/lyft-buys-motivate-bikesharing-systems/564347/>

Micromobility

desirable areas and a dearth in others, along with the questions of how to charge them and where to put them. (The former has already spawned a surprisingly cutthroat economy of “Bird hunters” paid to recharge them overnight in their homes.)²⁴

In late May 2018, the San Francisco Board of Supervisors voted to clear scooters from the streets ahead of applying for permits with the San Francisco Municipal Transportation Agency, which intends to cap the number of vehicles at a maximum of 2,500 as part of a one-year pilot.²⁵ Seattle is poised to follow suit with a cap of its own. The question is how many are necessary to make them attractive. The SFMTA’s original proposed cap of 500 was surely too small; Seattle’s will be close to 10,000. Testing and phasing is needed to determine the optimal size and equitable distribution.

As for where to put them, that’s simple: just assign them a parking space. In Washington, D.C., a city councilman has proposed adding bicycle racks to each of the district’s 7,700 intersections, at a cost of \$2 million to \$3 million. Meanwhile, Seattle’s Department of Transportation is considering repurposing reclaimed streets and parking spaces as corrals for dockless bikes and scooters.

In city after city—from Brooklyn, to Boulder, to Baltimore—bikelashes have battled against lane closures, space reclamation, and protected cycling lanes in the name of safety.

Typically, such proposals have sparked a “bikelash” from residents fiercely protective of their on-street parking. In city after city—from Brooklyn, to Boulder, to Baltimore²⁶—bikelashes have battled against lane closures, space reclamation, and protected cycling lanes in the name of safety. But cities that have pressed ahead in building or at least exploring dedicated cycling infrastructure have discovered huge latent demand. Eight miles of improvised lanes in Macon, Georgia, led to an 800 percent increase in cycling over the two weeks of the pilot. Bird has drafted the “S.O.S Pledge,” for “Save Our Sidewalks,” promising \$1 per vehicle per day toward building dedicated lanes, and daring its rivals to do the same.

The real battle will be with the micromobility services themselves, as cities are seeking new sources of revenue to pay for transit improvements and won’t get fooled again. “Cities are agitated by the congestion Uber and Lyft are causing, but instead of capping Uber and Lyft, they’re capping scooters, which could replace those trips,” protests one micromobility executive. “They’re contradicting their own goals.”

MIRCOMOBIILITY LANDSCAPE

	Station Based	Dockless Bike	Dockless E-bike	Dockless Scooter
Bird				●
Jump			●	
Lime		●		●
Mobike		●		
Motivate	●			
Ofo		●		
Skip				●
Spin		●		●

²⁴ <https://www.theatlantic.com/technology/archive/2018/05/charging-electric-scooters-is-a-cutthroat-business/560747/>

²⁵ <https://sf.curbed.com/2018/5/2/17311604/sfmta-scooter-cap>

²⁶ <https://www.wsj.com/articles/creating-bike-lanes-isnt-easy-just-ask-baltimore-or-boulder-or-seattle-1524043800>



03 | TRENDS AND INCUMBENTS

Autonomous Services

Washington, D.C., is where the robots meet the road. Since 2017, two-foot-tall delivery bots operated by London’s Starship Technologies have slowly traversed the district’s sidewalks and crosswalks in the course of delivering 7,000 food orders and packages on behalf of Postmates. Three were struck by cars, the company reports,²⁷ although in each case the robot had the right of way. In May, the D.C. Council voted to expand the pilot using language written in part by Starship.²⁸ One delivery bot on the sidewalk is cute, but what happens when they become a swarm? To dodge this dystopia, San Francisco preemptively banned most bots in 2017.

The prevailing assumption about autonomous vehicles is that they’ll ferry us from A to B. But what if they’re used primarily for carrying stuff instead? The U.S. Department of Commerce reports e-commerce sales grew 16 percent in 2017,²⁹ far outstripping growth

in vehicle miles traveled. Demand for warehousing has doubled the price of urban industrial land,³⁰ and some cities have already seen downtown parking converted to last-mile logistics hubs.³¹ The seemingly unstoppable rise of Amazon in the U.S. and Alibaba and JD.com abroad hints at a world in which more goods are in motion than ever, and that many cities’ first encounter with an AV may well be a delivery bot.

The prevailing assumption of autonomous vehicles is that they’ll ferry us from A to B. But what if they’re used primarily for carrying stuff instead?

Besides Starships, there are similarly shaped Robbys,³² washing machine-sized Marbles, and Piaggio Fast Forward’s Gita, a cross between a pet and a packbot. Nearly all pitch themselves to local businesses as a counter to Amazon’s same-day delivery, and to cities as a solution for increasingly crowded curbs.

The battle for the curb—one currently fought between delivery trucks, rides-for-hire, and old-fashioned double



Here are additional VC-funded companies launching delivery robots:

Dispatch | DeliveryBots | Amazon Prime Air

²⁷ <https://wtop.com/business-finance/2018/02/cars-hit-delivery-robots-dc-test/>

²⁸ <https://www.smartcitiesdive.com/news/delivery-robots-washington-dc-starship-last-mile/523094/>

²⁹ https://census.gov/retail/mrts/www/data/pdf/ec_current.pdf

³⁰ <https://www.recode.net/2018/1/3/16845162/two-day-shipping-e-commerce-double-warehouse-land-prices-last-mile>

³¹ <https://www.bisnow.com/chicago/news/industrial/what-the-move-toward-urban-fulfillment-centers-means-for-last-mile-logistics-78119>

³² <https://robby.io>

Autonomous Services

parking—threatens to spill over onto the sidewalk if delivery bots perceive them as a shortcut. This isn't solely an urban issue. Daimler, for example, has led a \$17.2 million investment round in Starship, and unveiled a van-based “mothership” for deploying bots in lower-density areas.³³

Fittingly, Sidewalk Labs spinoff Coord has proposed taking the logic of road pricing and extending it to the curb.³⁴ Its Curbs API has digitally mapped 200,000 curbs in four cities for the precise assignment of curb space and time as a precursor to charging by the minute or meter.³⁵ Although this raises concerns about accessibility, equity, and degradation of the public realm, it may become necessary as autonomous services seek to arbitrage unpriced real estate.

The battle for the curb—one currently fought between delivery trucks, rides-for-hire, and old-fashioned double parking—threatens to spill over onto the sidewalk if deliverybots perceive them as a shortcut.

An autonomous convenience store already wanders the streets of Shanghai,³⁶ while a Brooklyn-based startup, appropriately named Curbspace, offers mobile rooms by the hour, delivered to “the nearest available parking spot.”³⁷

What remains unclear is who will operate these networks and what other tools cities will have to regulate them. Will it primarily be retailers (Amazon), logistics providers (FedEx and UPS), and the U.S. Postal Service? Or will it be private fleets owned by employers,³⁸ residential buildings, and even municipalities? Rather than simply charge or let the robots run free, cities should find opportunities to deliver essential services as well, leveraging the same lower costs of deployment.

³³ <http://media.daimler.com/marsMediaSite/en/instance/ko/Mercedes-Benz-Vans-invests-in-Starship-Technologies-the-worlds-leading-manufacturer-of-delivery-robots.xhtml?oid=15274799>

³⁴ <https://www.fastcompany.com/40560626/digitizing-curbs-would-help-avs-and-humans-navigate-our-cities>

³⁵ <https://coord.co/>

³⁶ <https://themobymart.com> | ³⁷ <http://getcurbspace.com>

³⁸ <http://www.wired.co.uk/article/starship-technologies-robots-deliveries-intuit-compass-test>



03 | TRENDS AND INCUMBENTS

Mobility-as-a-Service (MaaS)

Early in 2018, new Uber CEO Dara Khosrowshahi announced his company's previously unspoken ambition to monopolize public transportation. "I want to run the bus systems for a city," he said in his first public remarks as CEO. "I want you to be able to take an Uber and get into the subway ... get out and have an Uber waiting for you."³⁹

Two months later, Khosrowshahi's intentions became clear in a series of deals to add bikesharing, car-sharing, and public transportation to Uber's app, the latter through a partnership with Masabi, which handles ticketing for New York, Chicago, and Boston, to name just a few. Uber wouldn't run the buses, but it would let you find and pay for one, along with an Uber waiting at the other end. And in doing so, it would own the relationship with you, the customer.

For years, transportation experts have imagined "mobility-as-a-service" (MaaS): a single app combining every mode, public and private, with the ability to find, book, and pay for your trip. MaaS was conceived as a

way for cities and transit agencies to integrate private services into their systems; instead, it appears Uber will integrate them first.

Broadly speaking, there are two ways to build a MaaS platform. One is from the top-down, working with vendors such as Daimler's Moovel Group to combine mobile wayfinding and ticketing for transit with private partners. An example is Portland's TriMet app, which includes Lyft and Car2Go alongside rail and buses. The bottom-up approach is embodied by Whim, a Finnish app offering monthly subscriptions in addition to fares, including a €499 all-you-can-travel plan.

In both cases, the appeal to cities is threefold. First, if drivers can be persuaded they will have access to a car when they need it, they will likely switch their daily commutes to other modes, reinforcing micromobility and public transport. Second, while MaaS operators may be private companies, like Whim, they should be more inclined to work closely with cities and transport authorities to secure their cooperation. Finally, switching from pay-

"I want to run the bus systems for a city. I want you to be able to take an Uber and get into the subway ... get out and have an Uber waiting for you."

DARA KHOSROWSHAHI
CEO, Uber

Mobility-as-a-Service (MaaS)

as-you-go to monthly subscriptions might increase revenues and weaken consumer resistance. (When was the last time you checked your smartphone bill?)

Needless to say, the barriers to adoption are high. Top-down platforms face costly and lengthy software integrations, incompatible systems even in the same regions, misaligned procurement cycles, and blanket refusals by private services to share the data necessary for multimodal trips. Hence Uber's gambit to integrate public transport rather than the other way around.

Both Uber and Lyft have been trending in the direction of MaaS for some time. In 2016, Uber tested monthly subscription packages for its UberPOOL ride-sharing product priced below transit fares.⁴⁰

In spring 2018, Lyft began testing packages of standard rides at various price points,⁴¹ and partnered with Baltimore to create Lyft-specific "mobility hubs" at five downtown bikesharing stations⁴², which in retrospect appears to have been a test ahead of a potential Motivate deal. Meanwhile, Uber has begun testing \$30 monthly

subscriptions for Jump bike in Sacramento and San Diego, significantly undercutting their competition.

The lesson for cities: If an open, scalable third-party MaaS platform fails to emerge, cities run the risk of losing their relationship with public transport customers to private operators who, all rhetoric aside, do not necessarily have their best interests at heart.

The lesson for cities: if an open, scalable third-party MaaS platform fails to emerge, cities run the risk of losing their relationship with public transport customers to private operators who, all rhetoric aside, do not necessarily have their best interests at heart.

"MaaS is what they should be doing," says Gabe Klein, the former commissioner of both the Chicago and Washington, D.C., Departments of Transportation and a partner of the consulting firm CityFi.⁴³ "They need to stop operating the bus and start focusing on the system from door to door. They're not, so Uber will."

Cities should draft MaaS roadmaps as soon as possible, adding route-finding and trip-planning features

to their transit apps (assuming they have one), and identifying potential partners for integration, including smaller players such as DemandTrans and Door2door, as well as larger entities such as Moovel, which is included in the Daimler/BMW connected mobility merger), and Ford, which is positioning its Transportation Mobility Cloud as a MaaS alternative to Uber.⁴⁴



While there is no clear, accepted MaaS roadmap in the U.S., the Conference of European Directors of Roads put together the first comprehensive MaaS roadmap. It may prove a model to the U.S.

⁴⁰ <https://www.forbes.com/sites/briansolomon/2016/08/24/uber-debuts-amazon-prime-style-ride-service-flat-fares-cheap-rides/#151e93286bc2>

⁴¹ <https://www.theverge.com/2018/3/15/17127002/lyft-all-access-monthly-subscription>

⁴² <https://technical.ly/baltimore/2018/02/15/lyft-baltimore-bike-share-partnering-transportation-hubs-baltimore/>

⁴³ Full disclosure: I'm an affiliate member of CityFi

⁴⁴ <https://techcrunch.com/2018/01/09/ford-and-autonomic-are-building-a-smart-city-cloud-platform/>

Seattle

In spring 2017, Seattle tore out its bikesharing stations. Pronto had fizzled, in part due to a relatively small number of bicycles (500) and limited coverage. That July, Seattle became the first U.S. city to welcome the dockless revolution rather than simply endure it. Within three months, nearly 9,000 bicycles supplied by Lime, Ofo, and Spin were roaming the city, suddenly home to America's second-largest municipal fleet.

A year later, the pilot is set to end in June, with Seattle's Department of Transportation weighing its options for how to structure ongoing permits. A cap on the total number of vehicles is a sure thing, although the city relies on self-reported numbers, according to Benjamin de la Peña, Seattle DOT's chief of innovation and strategy. Next is finding places to put them: the city is rolling out 1,500 designated spaces carved from on-street parking and reclaimed lanes.

Seattle's bicycle reboot is emblematic of the most successful transit city in the country, offering a model for how to increase the supply of transit, reform parking, and land use to encourage residents to ride it, and how to work with employers to change commuters' behavior. The city has added nearly a quarter million jobs in the last decade, and has grown in population by more than 15 percent since 2010. In that time, the number

of commuters driving private vehicles downtown has declined by 10 percent.⁴⁵ In 2016, voters approved a \$53.8 billion transit referendum doubling the region's light rail system, and the city's bus network gained 700,000 rides in 2017 at a time when ridership nationwide was experiencing a collapse.⁴⁶

Not every city can raise billions for transit or host Amazon, but they can learn from Seattle's policies. Its bus success, for example, is underpinned by downtown transit-only lanes. In April 2018, the city council passed a series of reforms decoupling rents and parking in Seattle's densest "urban villages." Developers aren't required to build off-street parking in newly expanded areas with frequent transit service, and they're allowed to rent spaces to owners who don't live or work in a specific building, further rationalizing the market.⁴⁷

Seattle is also home to a startup named Luum, which specializes in the dryly named field of transportation demand management (TDM). Luum works with local employers such as Swedish Hospital, Delta Dental, and the Gates Foundation to manage their supply of parking and other benefits, and to shape demand through incentives, rewards, and games. While the city takes parking away for bicycles and buses, Luum ensures commuters hardly miss them—and Seattle's virtuous circle continues.

The city bus network network gained 700,000 rides in 2017 at a time when ridership nationwide is experiencing a collapse.



Bottom line: Seattle demonstrates how land use and lane space are the most important tools at cities' disposal. Re-tasking transit-only lanes, reclaiming street space, and eliminating parking minimums are all translatable elsewhere.

⁴⁵ <https://www.citylab.com/transportation/2018/05/seattle-the-city-that-respects-the-power-of-the-bus/559697/>

⁴⁶ <https://kingcounty.gov/elected/executive/constantine/news/release/2018/February/21-metro-ridership.aspx>

⁴⁷ <https://seattle.curbed.com/2018/4/2/17190712/seattle-city-council-parking-reform-vote>

Columbus

Columbus, Ohio, shocked public transport circles in 2016 by winning the U.S. Department of Transportation Smart City Challenge. The poster child for post-industrial mid-sized Midwest cities had beaten 77 others to win \$40 million from the federal government and another \$10 million from Paul Allen's Vulcan, Inc..

It turned out Columbus's transit deficiencies—no rail to speak of, and falling bus ridership—were actually strengths in the selection process. “Our goal was to find a city big enough to have problems our grants could help solve, but small enough so you could see the impact,” former Secretary of Transportation Anthony Foxx recalled later.

Columbus's windfall highlights the many incremental steps necessary for small- and mid-sized metros to achieve a more equitable and connected transportation system. It also underscores the role private investment and employers must take in realizing a critical mass of supply and demand. The plans for “Smart Columbus,” for instance, call for first increasing renewables and quadrupling the number of electric vehicles sold by 2020, underwritten by Vulcan—including \$170,000 in rebates to residential developers installing charging stations. Next up is a transportation “operating system” unveiled in May 2018 with 1,100 open data sets to power future applications.

Creating more equitable access to transportation for the city's poorest neighborhoods and residents is a hallmark of the plan, including last-mile autonomous shuttles from bus stops to employment centers, and transit cards requiring neither a smartphone nor credit history. Of course, some proposals are more equitable than others.



Columbus' experience underscores the role private investment and employers must take in realizing a critical mass of supply and demand.

Shortly after Columbus won the challenge, Google's Sidewalk Labs made an unsolicited offer to run the city's traffic and parking on its own payment systems, and use vouchers to steer bus riders toward ride-hailing instead.⁴⁸ (The city declined.)

A year later, however, Columbus asked Sidewalk Labs to streamline a shuttle service for expectant mothers on Medicaid in the city's South Linden neighborhood as part of its goal to reduce infant mortality by 40 percent by 2020.⁴⁹ Sidewalk Labs' team drafted a plan using SMS texts to arrange doctor visits via traditional vans or ride-hailing services. A similar program in Flint, Michigan, offers heavily discounted rides to medical centers, farmer's markets, and bottled water distribution points in an effort to bridge racial and socio-economic disparities.⁵⁰ Sidewalk Labs' plans were shelved until fall 2017, after reporting by CityLab galvanized interest.⁵¹

But the success of Smart Columbus may ultimately lie with the 50 largest local employers composing the Columbus Partnership. Public-private partnerships are the “Columbus Way,” which, in this case, means working closely with employers, each of which has nominated senior leaders and “mobility ambassadors” to install charging infrastructure, discourage solo commutes through TDM (see Seattle, above), and underwrite alternatives such as Ford's Chariot shuttle service, which launched with J.P. Morgan Chase in January.

“This is where we think the private sector is so critical. Because if we focus on commuter traffic, we can start empowering car-light lifestyles,” says Jordan Davis, the Partnership's director for Smart City Columbus.

Bottom line: The lack of visible progress on Smart Columbus underscores how difficult it is for cities alone to initiate catalytic change. The city could prove to be a model for working hand-in-hand with the private sector, however, in providing new types of public/private transit and using next-generation TDM to fill them.

⁴⁸ <https://www.theguardian.com/technology/2016/jun/27/google-flow-sidewalk-labs-columbus-ohio-parking-transit>

⁴⁹ <https://www.citylab.com/transportation/2017/11/when-a-smart-city-doesnt-have-all-the-answers/542976/>

⁵⁰ <http://www.flintside.com/inthenews/rides-to-wellness-mta.aspx>

⁵¹ <https://www.citylab.com/transportation/2017/12/columbus-now-says-smart-rides-for-vulnerable-moms-are-coming/547013/>

Nashville

In April 2018, Nashville Mayor David Briley signed the “Declaration of Transportation Independence,”⁵² which held the truth to be self-evident that residents “find a way to untether ourselves from this mythology that freedom means being in a car,” he said.⁵³ But on May 1, his constituents rebelled, voting down a \$5.4 billion transit referendum that would have added 26 miles of light rail, four rapid bus lines and expanded service on current routes, a downtown tunnel, and a host of walking and biking improvements. Instead, Nashville has become a cautionary tale⁵⁴ of how to lose a transit referendum, and a case study of what to do when you can’t raise money for capital projects.

The Chamber of Commerce had thrown itself behind the mayor, arguing the improvements were necessary to continue attracting both employers and talent to the once-compact city adding 100 people a day in a now-slowing boom. Arrayed against them was an unlikely coalition of suburban voters arguing the improvements would do little to benefit them, and a downtown African-American community divided over gentrification and displacement.

“There’s a lot of people who believe if we vote to stop the growth, maybe the growth will stop coming,” says Erin Hafkenschiel, director of the Nashville Mayor’s Office of Transportation and Sustainability.

Nashville had hoped to follow in the footsteps of cities such as Los Angeles, Seattle, and Atlanta, that had

won permission from the state to vote on local transit initiatives. On Election Day 2016, this strategy produced victories in the cities mentioned above; prior to that, suburban Atlanta voters killed a \$8.5 billion referendum in 2012, and Austin had voted down light rail in 2014.

Nashville transit advocates had seen their own hopes dashed in 2014 after Koch brothers-backed PACs helped kill plans for a bus rapid transit line. This time around, opposition groups such as NoTax4Tracks and Better Transit for Nashville raised hundreds of thousands of dollars from a handful of donors to purchase Facebook ads and employ disinformation techniques last seen in presidential elections. One troubling lesson for cities from

Nashville’s defeat is that cutthroat political tactics are trickling all the way down to transit referendums.

“There’s a lot of people who believe if we vote to stop the growth, maybe the growth will stop coming,”

ERIN HAFKENSCHIEL

Director, Nashville Mayor’s Office of Transportation and Sustainability

So where does Nashville go from here? By law, the city is prohibited from calling another vote for at least a year, during which time it will host a series of elections for mayor. In the meantime, the Republican candidate for governor has called for lane widenings and double-decker highways as

a solution to congestion, while transit advocates have called for sidewalk improvements and cycling lanes. (Bird launched its scooter service in Nashville in May.)

“Dockless bikes and electric scooters are absolutely part of the last-mile solution going forward,” Hafkenschiel said. “Are they the only solution? Absolutely not.”

Bottom line: The failure of Nashville’s referendum underscores their political limitations. A poorly timed vote became more awkward still when the plan’s champion, Briley’s predecessor Mayor Megan Barry, resigned March 2018 due to scandal. Free to focus on a single issue, the plan’s opponents pulled no punches in galvanizing voters against it. Cities considering similar measures must be prepared for #FakeNews misinformation tactics. “It’s hard to discuss the issues without a shared set of facts,” Hafkenschiel said.



⁵² <https://transitindependence.com>

⁵³ <https://www.tennessean.com/story/news/2018/04/02/nashville-transit-briley-declaration/479009002/>

⁵⁴ <http://www.charlotteobserver.com/opinion/op-ed/article210363159.html>

Washington, D.C.

Underfunded transit systems make strange bedfellows, but few sights were stranger than Washington, D.C., Mayor Muriel Bowser publicly thanking the embassy of Qatar on Twitter in May 2018 for financing late-night Metro service following a Washington Capitals' NHL playoff game.⁵⁵ Metro had trimmed its weekday operating hours the year before due to budget constraints. To add insult to the injury of needing an oil-and-gas-rich emirate to cover the \$100,000 cost of running trains for an hour, the Washington Metropolitan Area Transit Authority (WMATA) had originally asked the Capitals to foot the bill. The team declined.⁵⁶

This was only the latest chapter in the tragic saga of America's second-largest transit system veering frighteningly close to being a failed state. Washington, D.C., has become an unhappy testbed for new mobility due to a confluence of underfunded transit, dysfunctional governance, and private services more than happy to pick off choice riders.

A yearslong downward spiral of declining Metro rail ridership and service, compounded by rising costs, culminated in 2016's "Metropocalypse": a system-wide emergency shutdown, followed by years of deferred maintenance compressed into months, requiring line closures for weeks at a time. The resulting 14 percent fall in ridership was steep enough to drag national numbers into the red.⁵⁷

Ride-hailing startups poured into the District, offering promotional fares priced below transit. Capital Bikeshare ridership boomed. Two years later, emergency repairs are mostly complete, but ridership remains depressed and WMATA general manager Paul Wiedefeld estimates the system will need another \$15 billion over the next decade for maintenance, nearly half of which is unfunded. If necessity is the mother of invention, then

Metro's austerity has since given birth to both a thriving micromobility scene and an idea for how it might pay for transit.

Like Seattle, the city authorized dockless services in a bid to expand the socioeconomic and geographic footprint of bikesharing in the District. Seven companies took them up on it in a pilot that now runs through August 2018: Spin, Mobike, and Ofo with bicycles; Jump with electric bicycles; Bird and Skip (née Waybots) with scooters, and Lime with all of the above.

Happily, Washington has discovered that more is more: Aggregating all the competing services together, plus Capital Bikeshare, means there's a 91 percent chance of finding one within a quarter-mile radius at rush hour, according to users of Transit app.⁵⁸ Unhappily, the competing services remain balkanized, and bike clutter prompted the District Department of Transportation to propose new regulations in April 2018 that would have included fees roughly equal to \$200 per bicycle. After a backlash by operators, the idea was scrapped.⁵⁹

The city has since turned its attention to taxing ride-hailing instead. Mayor Bowser's proposed fiscal 2019 budget includes \$178.5 million for WMATA—the District's contribution to the \$500 million annually Wiedefeld has requested from the city, the states of Maryland and Virginia, and the federal government. To pay for this, Bowser's next budget proposes a 4.75 percent fee on ride-hailing trips to raise approximately \$17 million. Although Chicago and Boston also levy fees on ride-hailing trips, and New York is set to charge ride-for-hire vehicles flat fees for entering lower Manhattan in a bid to raise \$400 million, Washington's cut is considerably higher than the former, and its land mass is twice the size of Manhattan.

Although congestion pricing similar to London's remains off the table in even America's densest, most congested cities, the surcharges on ride-hailing (and soon, micromobility) signal that cities are determined to claw something back for undermining taxis and transit.

⁵⁵ <https://twitter.com/MayorBowser/status/997154899883384832>

⁵⁶ <https://www.usatoday.com/story/sports/nhl/2018/05/17/qatar-helps-keep-us-capital-city-subway-open-for-nhl-fans/35036153/>

⁵⁷ <https://www.washingtonian.com/2017/03/10/metros-ridership-fell-so-much-in-2016-it-dragged-down-all-us-subway-ridership/>

⁵⁸ <https://medium.com/transit-app/docked-vs-dockless-bikes-five-months-in-a86ac801f4c7>

⁵⁹ https://www.washingtonpost.com/local/trafficandcommuting/dc-withdraws-plan-targeting-dockless-bike-operations-with-fees-and-parking-demands/2018/04/28/2d89c64e-48ca-11e8-827e-190efaf-1f1ee_story.html?utm_term=.54cc078bfd4d

Washington

Although congestion pricing similar to London's remains off the table in even America's densest, most congested cities, the surcharges on ride-hailing (and soon, micromobility) signal that cities are determined to claw something back for undermining taxis and transit. As WMATA board chair and D.C. Councilmember Jack Evans told *The Washington Post*: "Uber and Lyft are part of the transit system here, and so they should help pay to fix Metro because they're benefiting from Metro's demise."



A few days after Bowser's thanks to Qatar, after the Capitals had won to play another game, Metro announced it had procured a new sponsor to run the trains an extra hour: Uber.

Bottom line: By now, it's clear ride-hailing has increased congestion and vehicle miles traveled in every city that's collected data.⁶⁰ It's past time cities recoup compensation from companies aggressively competing against transit. Cash is good, but data is better—which the District Council is demanding in the face of intense lobbying pressure—if cities are to ever pull Uber, Lyft, et al. into their transit planning.

⁶⁰ <https://www.citylab.com/transportation/2018/04/how-uber-and-lyft-could-do-better-by-the-planet/558866/>

Scenarios

If Seattle, Columbus, Nashville, and Washington, D.C., represent four snapshots of the state of play in American mobility, what do they tell us about the future?

Each represents a particular expression of a number of variables, including governance, finance, density, land use, technology, and legacy investments in public transport (or lack thereof). If we were to tune a few of these variables differently, what future cities could we create?

Solar suburbs are the obvious trajectory for growing mid-sized cities in the Sun Belt and prosperous corners of the Midwest. In this imagined future, the falling costs and steadily increasing efficiency of both photovoltaic panels and batteries make clean electrons practically too cheap to meter. Elon Musk's vision of a Tesla Solar Roof™ on every McMansion, coupled with a Powerwall and an autonomous Model 3 in every garage, becomes the standard for exurbs across the Southeast.

Repeated failures to pass transit expansions in Nashville, Austin, and Charlotte lead frustrated business communities to take matters into their own hands. Working with Ford Chariot, [Volkswagen](https://www.volkswagen.com)⁶¹, and [Apple](https://www.apple.com)⁶², they conspire to create employee-only AV shuttle networks that quickly become the envy of commuters. (Ford Chariot has already started in Columbus in partnership with JP Morgan Chase.)⁶³ Parking at luxury malls such as Columbus' Easton Town Center is gradually torn out and converted to new mixed-use development as "lifestyle centers" that finally live up to their names.

Rovervilles combine high density, Seattle's enlightened approach to land use, high transit ridership, and the

triumph of micromobility. "Rovers"—a new species of AV coined by the Bloomberg Aspen Initiative on Autonomous Vehicles—are the product of a Cambrian explosion in lightweight electric vehicle design, as Chinese factories that once produced hoverboards pump out autonomous scooters by the millions.

Cheap, easy to make, and permitted to traverse bicycle lanes, rovers soon devour ride-hailing companies from the inside out. Emboldened cities restrict traffic arteries to transit and micromobility, using road- and curb-pricing as deterrents to keep rovers and delivery bots from flooding the zones. The result is ever-denser cities, as the radius of accessible neighborhoods widens and building heights ratchet up.

Powered by Uber™ extrapolates from Washington's woes. As bus ridership plummets into freefall and the federal government turns its back on transit, Uber CEO Dara Khosrowshahi receives his wish to run cities' transit systems on Uber's platform. He isn't alone—Apple, Alphabet AT&T, Fiat Ford, and BMW Daimler all offer competing platforms, complete with inter-city roaming agreements.

Mobility-as-a-service, here at last, proves to be a boon for many urban residents, as Uber's combination of TDM and fleet management simultaneously learns commuters' preferences while also nudging them toward the most profitable mode in its network for any given trip. But it proves to be the bane of many more marginalized by poverty, felonies, poor credit, or anything less than a 4.9-star rating. Although legally required to provide universal service, those deemed untrustworthy by the app are steered toward cities' frayed trains and buses, with no means for appealing the algorithm's decision.

⁶¹ <https://www.moia.io>

⁶² <https://www.nytimes.com/2018/05/23/technology/apple-bmw-mercedes-volkswagen-driverless-cars.html>

⁶³ <https://techcrunch.com/2018/01/17/chariot-expands-to-columbus-ohio-with-jpmorgan-chase-commuter-shuttle/>

Conclusion

Two years ago, in 2016, this paper would have contained no mentions of “micromobility,” or suggested that Uber might one day be known for its electric bicycle fleet or mobility-as-a-service offerings. Just as cities were beginning to come to grips with how they might begin to regulate ride-hailing services, the game has changed again.

The lesson is that cities cannot and shouldn’t try to keep pace with fast-cycle technological change. As Seattle’s example suggests, success may ultimately lie in future-proofing cities through the use of their core assets and

regulatory authority—streets, curbs, parking, zoning, and taxation—against autonomy and whatever comes after. (Cue the air taxis.)

As ever, cities’ greatest challenge isn’t the next nimble predator, but mustering the political will to protect and invest in transport on behalf of everyone. The good news is that mobility has never been more exciting: The zeitgeist is on your side. Good luck.