The Future of Urban Mobility and Implications, Risks and Opportunities for Transit

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We'll Get You There

Transformations – Past and Future

Easter morning 1900: 5th Ave, New York City. Spot the automobile.

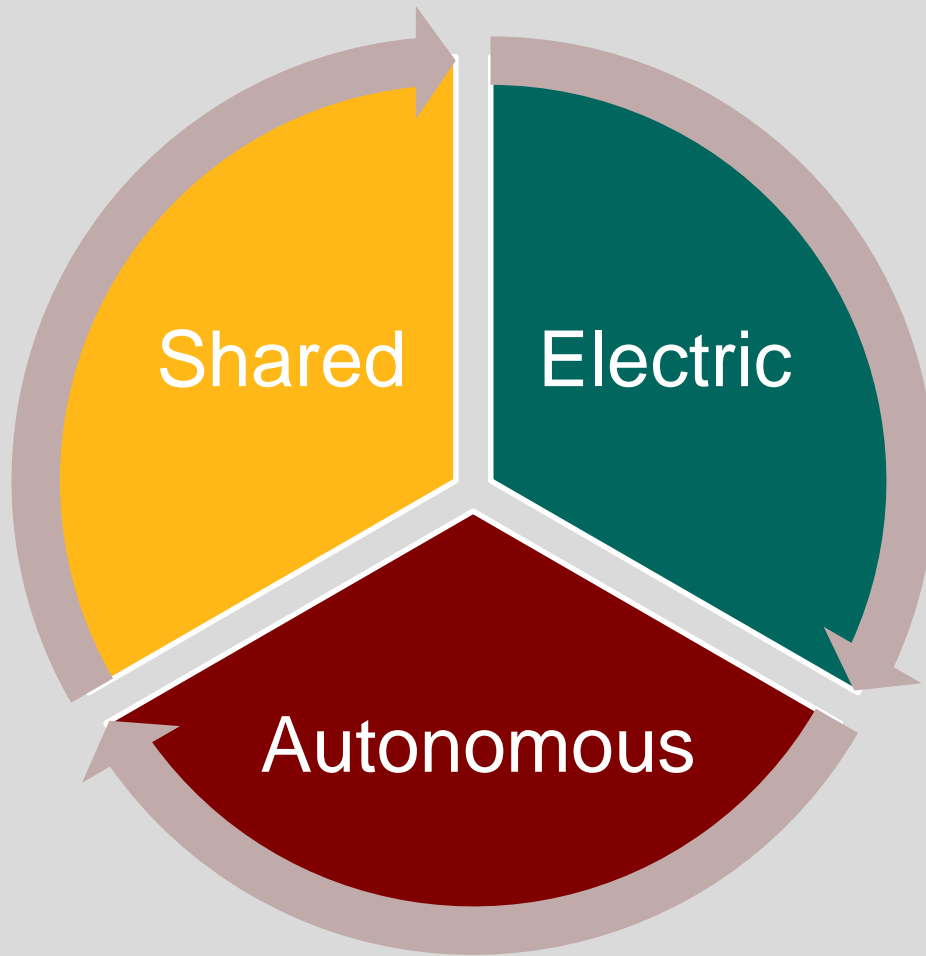Source: US National Archives.

Easter morning 1913: 5th Ave, New York City. Spot the horse.

Source: George Grantham Bain Collection.

With the rise of shared mobility and vehicle automation, we are on the cusp of an equally profound and swift revolution in human mobility as the early 1900s

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The Flywheel of Shared, Electric & Autonomous Paradigms

- Shared mobility, electrification and car automation, each can and does exist on its own

- Together, they create a flywheel effect, technologically and economically

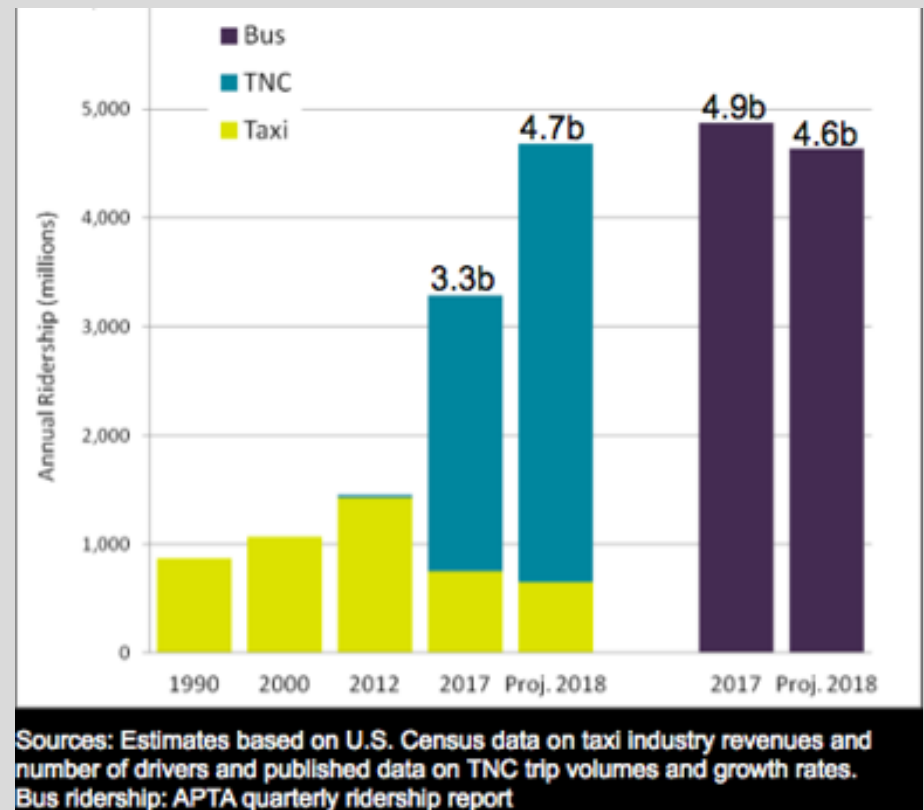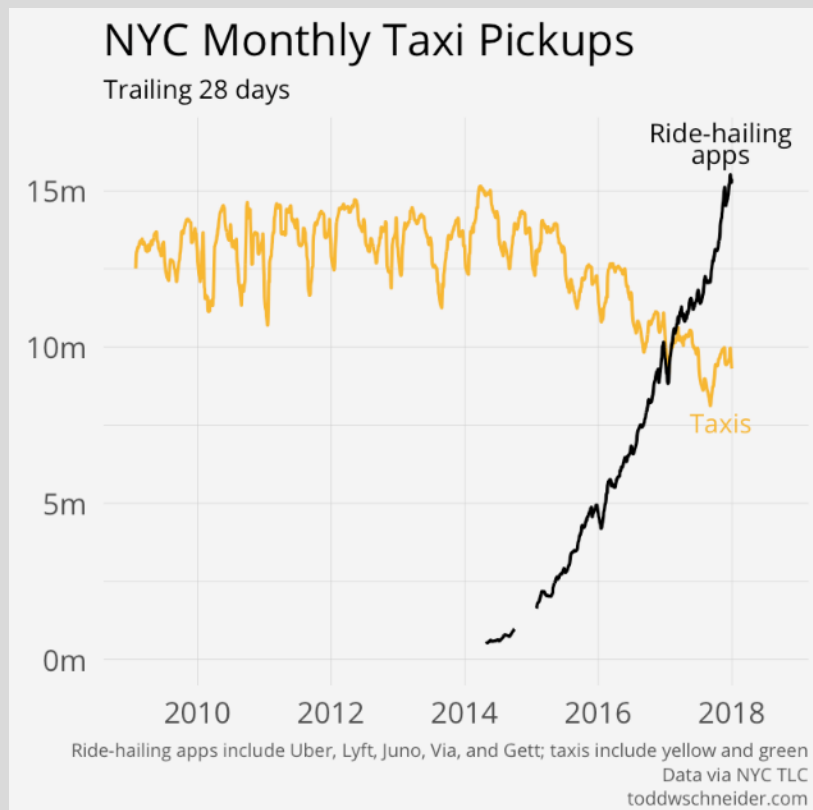- Important to think of each in the context of the others

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Shared Mobility

- Ridehailing, Carshare, e/Bikes & Scooter share, Microtransit and more

- Enabled by 4G+ networks, smartphones, app ecosystem and cloud computing
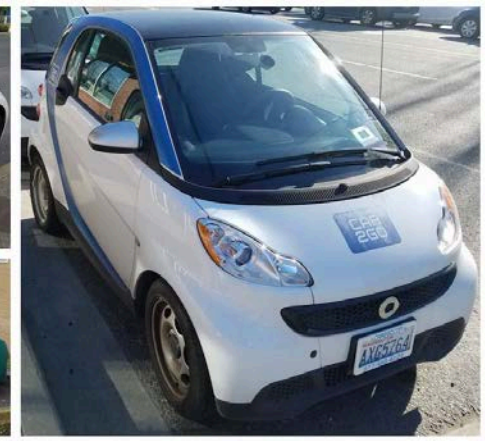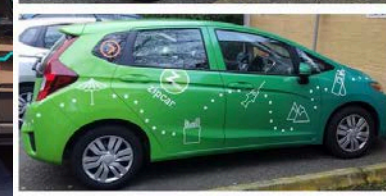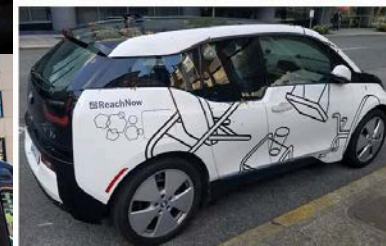
Pace and Scale of the Rise of Ride-hailing/TNCs

- Faster, more flexible and convenient than transit, taxis and SOVs

- Meteoric rise

NYC Monthly Taxi Pickups
Trailing 28 days

Ride-hailing apps include Uber, Lyft, Juno, Via, and Gett; taxis include yellow and green
Data via NYC TLC
toddwschneider.com

Sources: Estimates based on U.S. Census data on taxi industry revenues and number of drivers and published data on TNC trip volumes and growth rates. Bus ridership: APTA quarterly ridership report

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TNCs likely pulling from, not complementing, Transit

- *Uber and Lyft are adding car trips to city and suburban streets, and in many cases, cannibalizing transit* – UC Davis Research Report covering 7 U.S. Metros

- *TNCs are pulling from, not complementing, public transit and contributing to slower traffic* - Analysis by Bruce Schaller in NYC and MAPC in Boston

**Figure 12. Changes in transit use, biking, and walking after adoption of ride-hailing services**

Mode	Change
Public bus	-6%
Heavy rail	3%
Light rail	-3%
Bike	-2%
Walk	9%
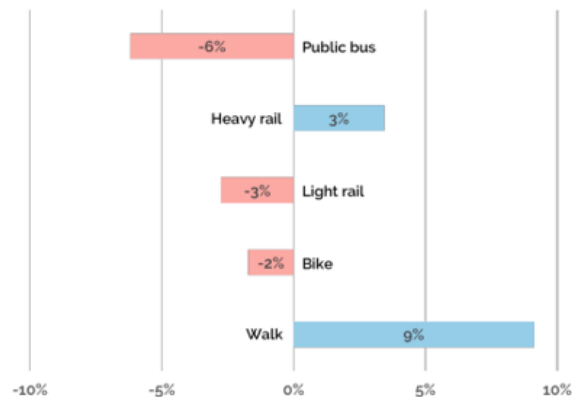
Survey question: "Since you started using on-demand mobility services such as Uber and Lyft, do you find that you use the following transportation options more or less?"

(UC Davis Institute of Transportation Studies)

Figure 14. Mode substitution, weighted by frequency of ride-hailing use

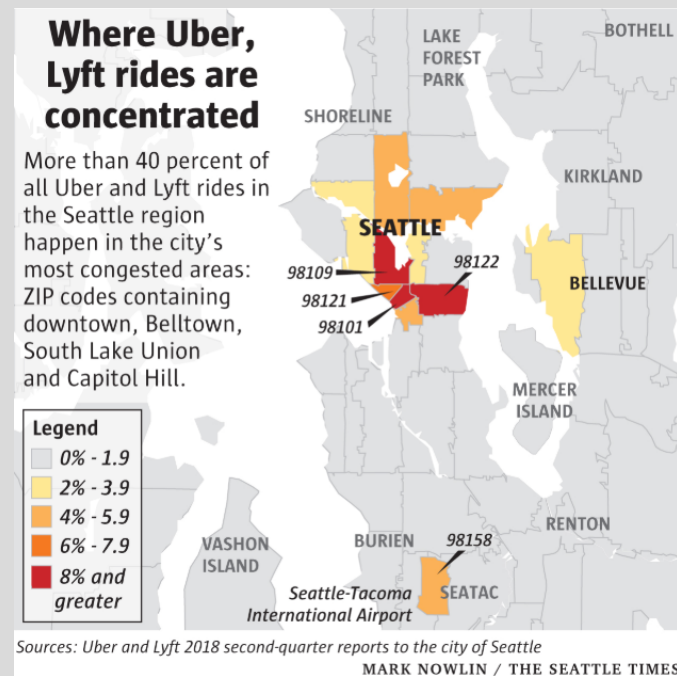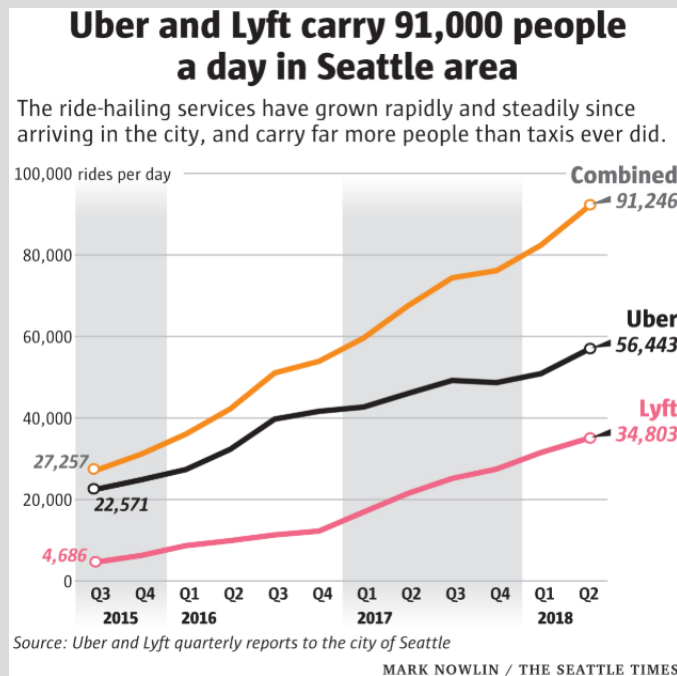| Mode	Percent
Fewer trips	22%
Walk	17%
Bike	7%
Rail	15%
Carpool	18%
Drive	21%
Taxi	1%
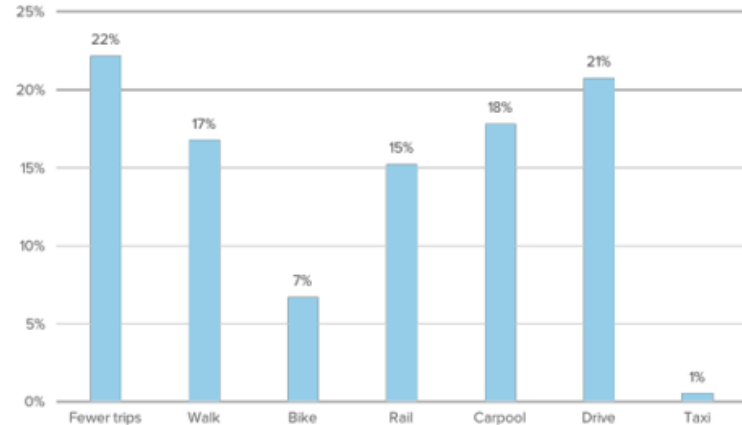
Survey question: If Uber or Lyft were unavailable, which transportation alternatives would you use for the trips that you make using Uber or Lyft?

(UC Davis Institute of Transportation Studies)

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TNC Growth and Implications for Mobility in King County

- 40% of Uber and Lyft rides in the 39 city region taking place in just four neighborhoods of City of Seattle…

- … that are already densest, most congested, as well as best served by frequent transit, bike lanes and walkable streets

Uber and Lyft carry 91,000 people a day in Seattle area

The ride-hailing services have grown rapidly and steadily since arriving in the city, and carry far more people than taxis ever did.

100,000 rides per day

Combined — 91,246

Uber — 56,443

Lyft — 34,803

27,257

22,571

4,686

Q3 Q4 | 2015
Q1 Q2 Q3 Q4 | 2016
Q1 Q2 Q3 Q4 | 2017
Q1 Q2 | 2018

Source: Uber and Lyft quarterly reports to the city of Seattle

MARK NOWLIN / THE SEATTLE TIMES

Where Uber, Lyft rides are concentrated

More than 40 percent of all Uber and Lyft rides in the Seattle region happen in the city's most congested areas: ZIP codes containing downtown, Belltown, South Lake Union and Capitol Hill.

Legend
- 0% - 1.9
- 2% - 3.9
- 4% - 5.9
- 6% - 7.9
- 8% and greater

Sources: Uber and Lyft 2018 second-quarter reports to the city of Seattle

MARK NOWLIN / THE SEATTLE TIMES

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Ride-hailing Needs Vehicle Automation for Growth & Profits

- Rapid and meteoric rise faced with growth and margin challenges

- Negative margins (operating loss of 40 cents for each dollar of revenue)

- Driver supply issues

- Growth ceiling ($2.50 vs. $0.60 cost/mile of SOV)

- Needs AVs to achieve sustained growth and positive margins

"Autonomous cars are the only way to get the cost down" from $2.50 per mile for a typical UberX ride to $1 per mile, a level that would tempt city and suburban residents to stop owning cars.

- Uber CEO Khosrowshahi at Goldman Sachs conference in Feb'18

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Automation and Vehicle Size

- All Autonomous Vehicles are NOT created equal

- Light Duty Vehicle (LDV) Automation – Passenger Car

- Heavy Duty Vehicle (HDV) Automation – Commercial Truck

- Transit Bus Automation

- Each with vastly different economics, incentives, business models, technological challenges and societal impacts

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Levels of Vehicle Automation

The 5 levels of driving automation

For on-road vehicles

| | Human driver | | Automated system |

		Steering and acceleration/ deceleration	Monitoring of driving environment	Fallback when automation fails	Automated system is in control
0	NO AUTOMATION				N/A
1	DRIVER ASSISTANCE				SOME DRIVING MODES
2	PARTIAL AUTOMATION				SOME DRIVING MODES
3	CONDITIONAL AUTOMATION				SOME DRIVING MODES
4	HIGH AUTOMATION				SOME DRIVING MODES
5	FULL AUTOMATION				

Human driver monitors the road

Automated driving system monitors the road

Source: SAE International

Vox

Level 4 automation is expected to make self-driving cars viable in urban environments

Key Distinctions & Examples

- Completely manual
- Most cars pre 1990

- Cruise control
- Most cars since 2000

- Adaptive cruise control + self-steering
- Most luxury cars today

- Adaptive cruise control + self-steering at most times
- Tesla Autopilot

- Full autonomy – mapped areas only
- Waymo AV service live in Phoenix

- Full autonomy – anywhere, in any conditions
- Unlikely to be available for several years

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Passenger Car Automation Needs Shared Mobility

- A typical car today is parked 95% of the time

- Makes individual ownership of Autonomous LDVs impractical

- Fleet based ownership providing on-demand mobility service

- The shift from 'productization' to 'servitization' to 'securitization' is critical to making the economics of LDV automation work

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Despite benefits, AV/Robo-Taxi based Ride-hailing will not solve Urban Mobility, and could even worsen it

- Autonomous LDVs will improve safety, roadway capacity, and enable cheaper travel and more productive use of time

- Autonomous LDVs will also lower Ride-hailing costs and could exacerbate the shift away from high capacity and active transport

- How many elephants can you fit in a wineglass?

- How many AV taxis on a city street?

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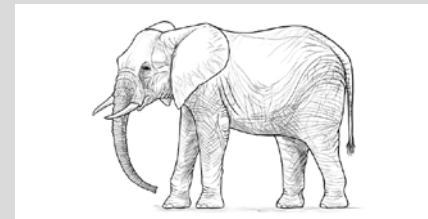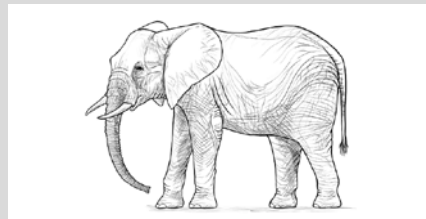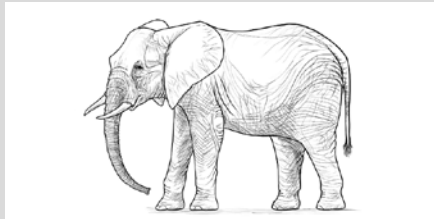
Solving for Urban Mobility Requires
Solving for the Geometry of Dense Environments
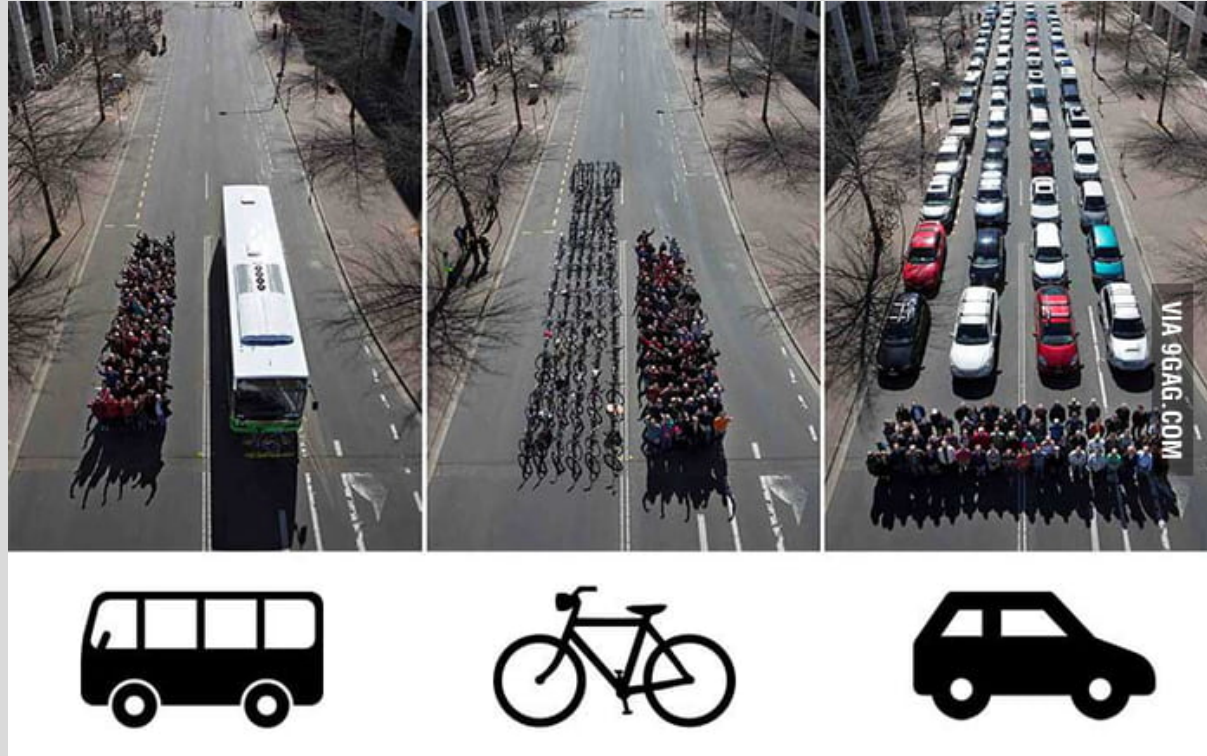
Transport lots of people in a single large vehicle (aka Transit)

Get them to ride vehicles no larger than themselves (Micromobility)

5000 lbs. passenger car (even if self-driven) is still just as space inefficient

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Transit alone cannot solve Urban Mobility either – Transit's Ridership-Coverage Tradeoff

- Competing demands of **Seeking Ridership** (service where lots of people ride) **Vs. Ensuring Coverage** (service to ensure that everyone can ride)

- Only 50-60% of transit is ridership seeking; The more coverage service you offer the less ridership you can seek

Environment/ Use Case	Ridership Vs. Coverage	Examples
Dense Urban	Ridership	Rapid Ride E Line
Intercity Suburban	Ridership	ST545, ST522
Low Density Suburban	Coverage (Spatial)	Route 201 (Deleted)
First and Last Mile Connectivity	Coverage (Spatial)	Largely absent
Off Peak/ Late Night	Coverage (Temporal)	Most routes

- Shared Mobility and LDV automation can serve coverage needs better than Transit ever can

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Two Futures

Marginalized Transit

- Shared AV Taxis draw riders from transit
- Higher VMT, congestion, and energy use
- Personal convenience; missed societal benefits
- Transportation gets highly inequitable

Transit at the center

- Transport network with transit as the backbone
- AND Shared AV Taxis complement transit
- AND Micromobility services & infrastructure
- Fewer vehicles; Lower VMT, congestion &energy use
- Lower overall costs and more equitable access

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To realize the right future…
Transit and cities need to rethink the 'Job To Be Done'

Railroads in the 20th century
Running trains vs. providing transportation

**Kodak Corporation in 1990s**
Providing film vs. Helping capture memories

- Rethinking the 'Job to be done'
  - From running bus and train service to ensuring mobility
  - Becoming multi-modal mobility managers
- If we don't, we risk not only the demise of Transit, but also a deteriorating urban livability and transport inequity

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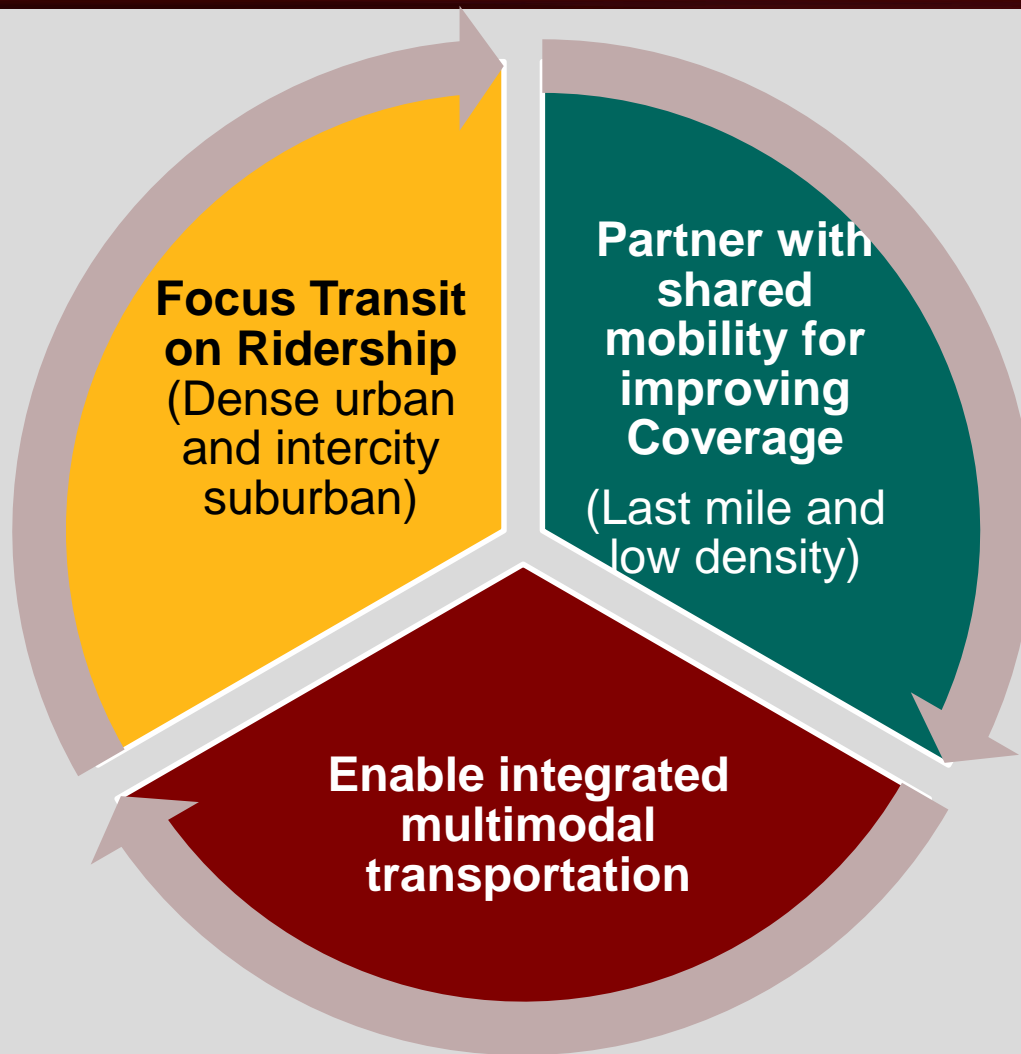# Ensuring mobility as the new 'Job To Be Done'

MOBILITY AS A SERVICE
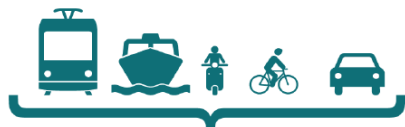
- Ensuring near point-to-point mobility for most citizens at most times without the need for a car would require

  – Rightsizing every motorized trip by demand
  – Large vehicles for long distance and dense environments
  – Small vehicles for short distances and sparse environments
  – Seamless, integrated experience across modes

- Regional cities should then be vying:

  – not for share of service hours and number of routes
  – but for coverage, quality and equity of service

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Realizing the Right Future – Metro's Mobility Strategy

Focus Transit on Ridership (Dense urban and intercity suburban)

Partner with shared mobility for improving Coverage (Last mile and low density)

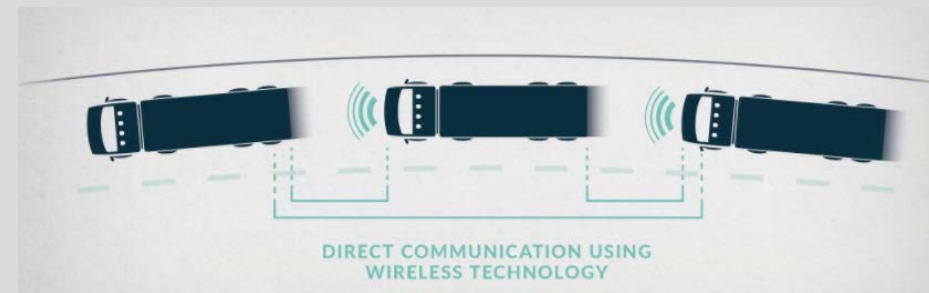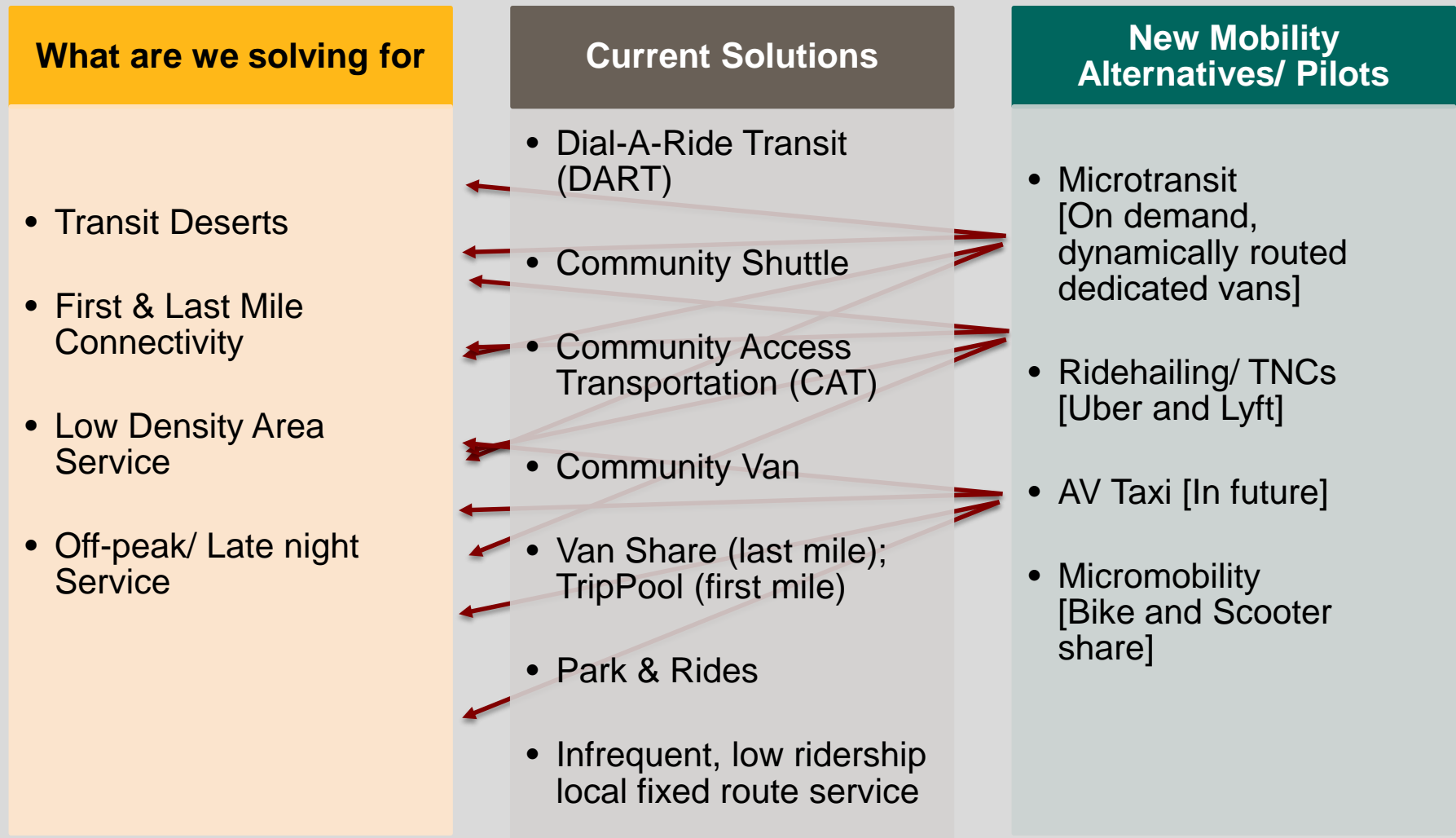**Enable integrated multimodal transportation**

A Mobility system

- that deploys and integrates the most efficient and effective modes for each trip;

- ensuring near point-to-point mobility for most citizens at most times without the need for a car;

- is at the very basis of how we ensure mobility equity and sustainability

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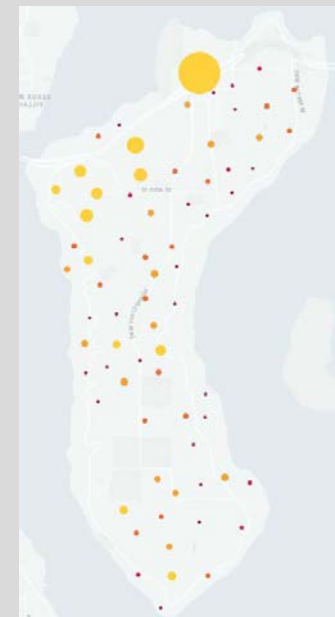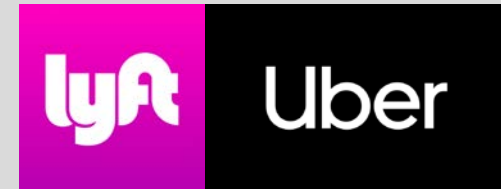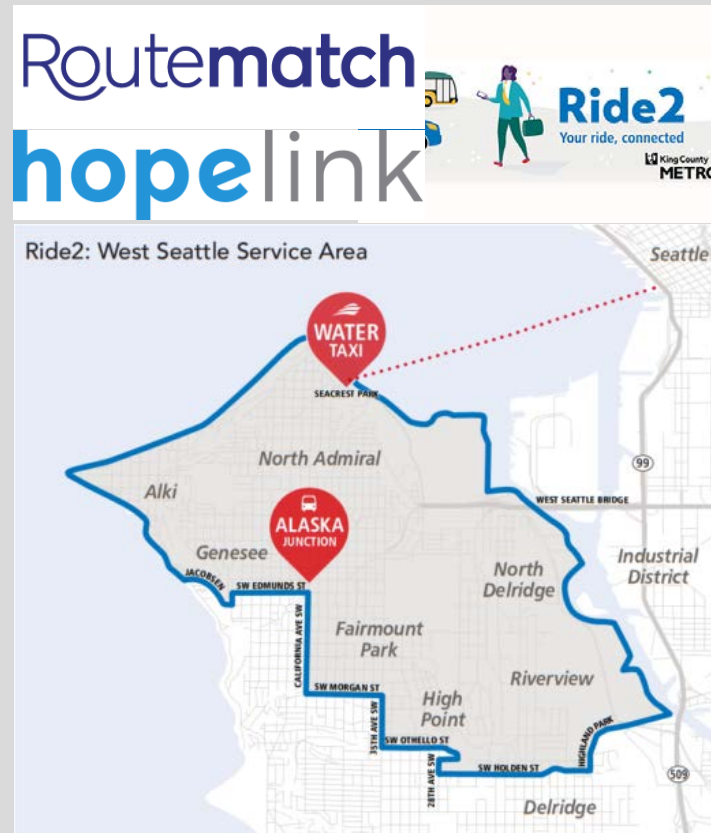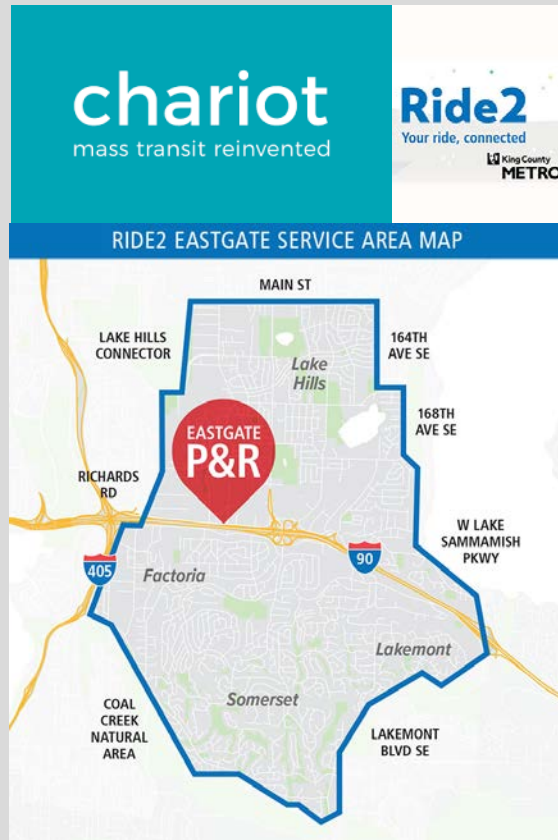METRO

Fixed Route Transformations on the Horizon

- **Location based data services** to precisely determine travel patterns and flows for network design and service planning

- **Bus automation:** A potential game changer with space efficiency of large vehicles with dramatically lower operating cost

- Not in sight yet and the timing is unknown. But critical for public transit to embrace, to avoid the risk of privatization of transit

- In-depot automation and platooning for BRT could come sooner and should be embraced

- Transit needs a proactive approach to minimize workforce impact, maximize new employment opportunities and ensure smooth transition

Overview of New Data Sources

LOCATION-BASED SERVICES DATA

Large sample size, Frequent pings, Spatial precision, Persistent ID, Anonymized

Identify trip ends, Obtain travel purpose, Resident vs. Visitor, Assign demographics Study before vs. after, Seasonal/yearly changes

DATA PROCESSING

DIRECT COMMUNICATION USING WIRELESS TECHNOLOGY

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Finding alternative, shared mobility based solutions for coverage based service will require smart and bold experimentation

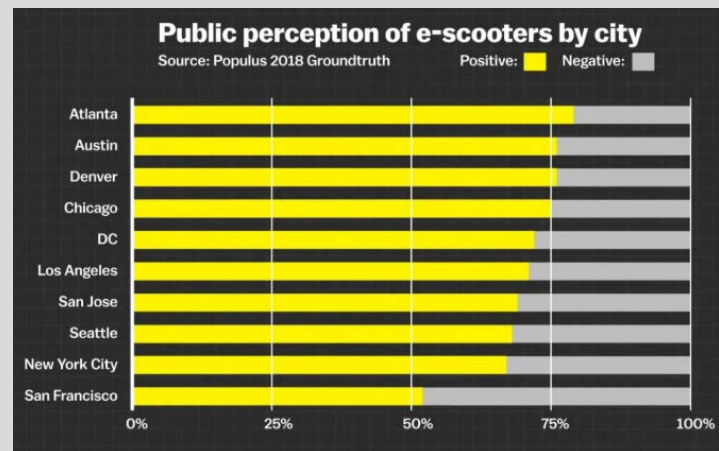| What are we solving for	Current Solutions	New Mobility Alternatives/ Pilots
• Transit Deserts • First & Last Mile Connectivity • Low Density Area Service • Off-peak/ Late night Service	• Dial-A-Ride Transit (DART) • Community Shuttle • Community Access Transportation (CAT) • Community Van • Van Share (last mile); TripPool (first mile) • Park & Rides • Infrequent, low ridership local fixed route service	• Microtransit [On demand, dynamically routed dedicated vans] • Ridehailing/ TNCs [Uber and Lyft] • AV Taxi [In future] • Micromobility [Bike and Scooter share]

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Benefits of Micromobility are Substantial

- Flexible and affordable mobility option + First/Last Mile connection to transit
- Beginning to replace cars and rideshare at 0-3 mile range*
- Offers highest space efficiency; helps reduce congestion
- Carbon neutral to negative
- Bird and Lime both hit 1 mil rides in 1 year; Uber and Lyft took 2.5 years for the same
- Higher usage among low income groups; substantial impact on lowering mobility poverty **
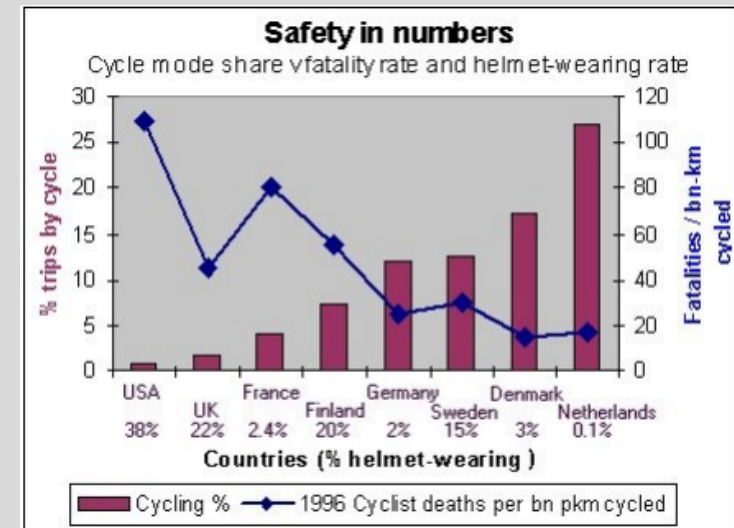

Charting The Growth Of Bird & Lime's Total Ride Counts, Based On Company Reports

crunchbase news

Public perception of e-scooters by city
Source: Populus 2018 Groundtruth   Positive: [yellow]   Negative: [grey]

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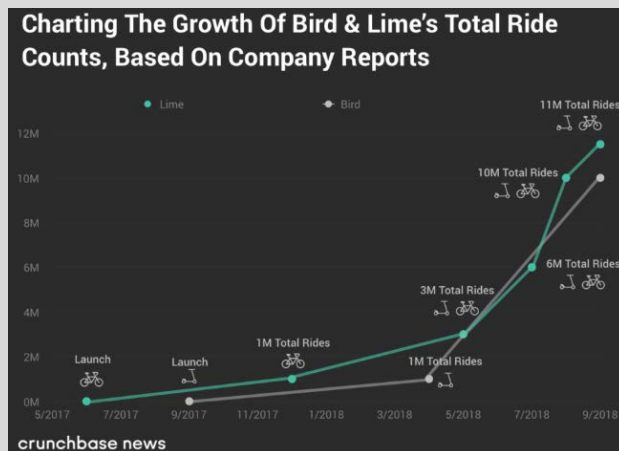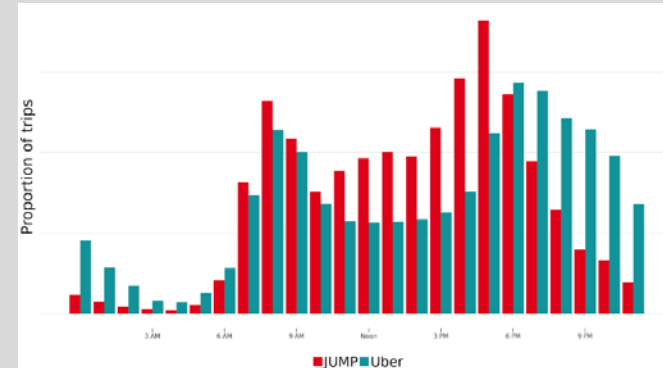
Well Regulated (vs. Prohibited) Micromobility

- Sidewalk riding, unruly parking, and rider and pedestrian safety are all real concerns

- Largely the symptoms of a root cause – Missing/ Inadequate infrastructure (see Safety in Numbers graph)

- Need dedicated bike lanes; dedicated bike parking

- Need regulation that defines speed, weight and ROW limits vs. outright bans and arbitrary quotas

- Regulation harmonized across the region. Imagine 39 cities each with their own rules for cars

Safety in numbers
Cycle mode share v fatality rate and helmet-wearing rate

Country	% helmet-wearing
USA	38%
UK	22%
France	2.4%
Finland	20%
Germany	2%
Sweden	15%
Denmark	3%
Netherlands	0.1%

Countries (% helmet-wearing)

Legend: Cycling % ■ — 1996 Cyclist deaths per bn pkm cycled ◆

Enabling Integrated Multimodal Transportation

- **Multimodal Integration**: Policies to promote open data standards and mobility data sharing across modes and providers (Transit, Bike Share, Ride-hailing feeds), to enable integrated trip planning and payments, without mobility walled gardens

- **Transit Fare Payments System (ORCA):** that can be seamlessly integrated with other mobility providers and payment platforms

- **Pricing Mechanisms:** Congestion, Vehicle Miles Traveled, Occupancy Based Pricing

- **New Mobility Regulation:** that responsibly permits modal innovation (scooter-share, AVs etc.) rather than prohibiting it and is harmonized across the region (vs. patch-work)

- **Land use policies** that incentivize taller, denser, mixed built environment with lower parking requirements, drop off zones, shared curb space and mobility hubs

- **Policy support for Public Private Partnership based delivery**: Focusing transit on Ridership, subsidizing private delivery for Coverage, and ensuring equity and integration

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Q & A

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