



CENTER FOR  
AUTOMOTIVE  
RESEARCH

# The Future of Mobility

How do we get there from here?

Valerie Sathe Brugeman

Assistant Director, Center for Automotive Research

Transportation Innovation Forum

May 28, 2019

# Agenda

## Emerging Technologies

- Automated
- Connected
- Electric

## New Mobility Service Models

- Shared

## Deployment and Adoption



# Emerging Technologies

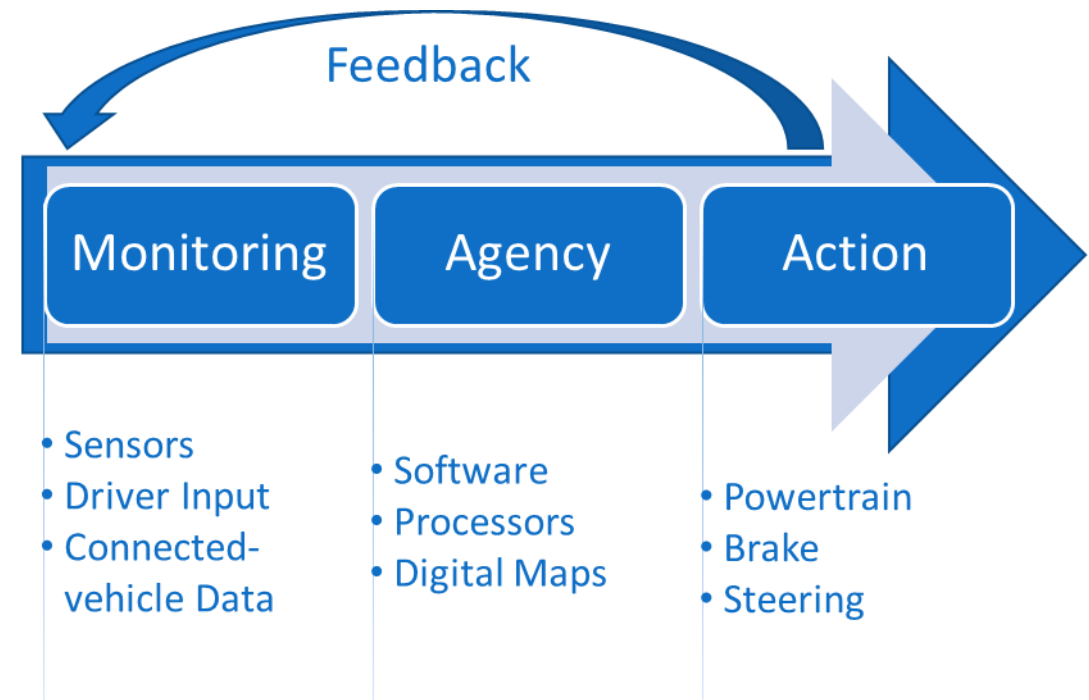
Automation

Connectivity

Electrification

# Automated Vehicle Systems

Influences the lateral and/or longitudinal motion of a vehicle beyond what a human driver directly controls





# SAE J3016 Levels of Driving Automation



# Sensors for Automated Driving and ADAS

## Relative strengths

Requirement	Camera	Radar	Lidar
Large Object (Vehicle) Detection	4	5	5
Medium Object (Pedestrian) Detection	4	3	5
Small Object (Cat) Detection	4	2	4
Object Location/Distance Estimation	3	4	5
Radial Velocity Estimation	3	5	4
Object Classification	4	1	3
Low Light	3	5	5
Weather Occlusion (Fog/Precipitation)	3	5	4
Direct Sun	2	5	4
Recognize Lane Markings and Road Signs	5	1	2
Localization and Mapping	3	3	5

1 = Prohibitive  
 2 = Possible  
 3 = Potential  
 4 = Promising  
 5 = Proven

Highly capable systems will likely require all three.

Source: Research by CAR/AAA

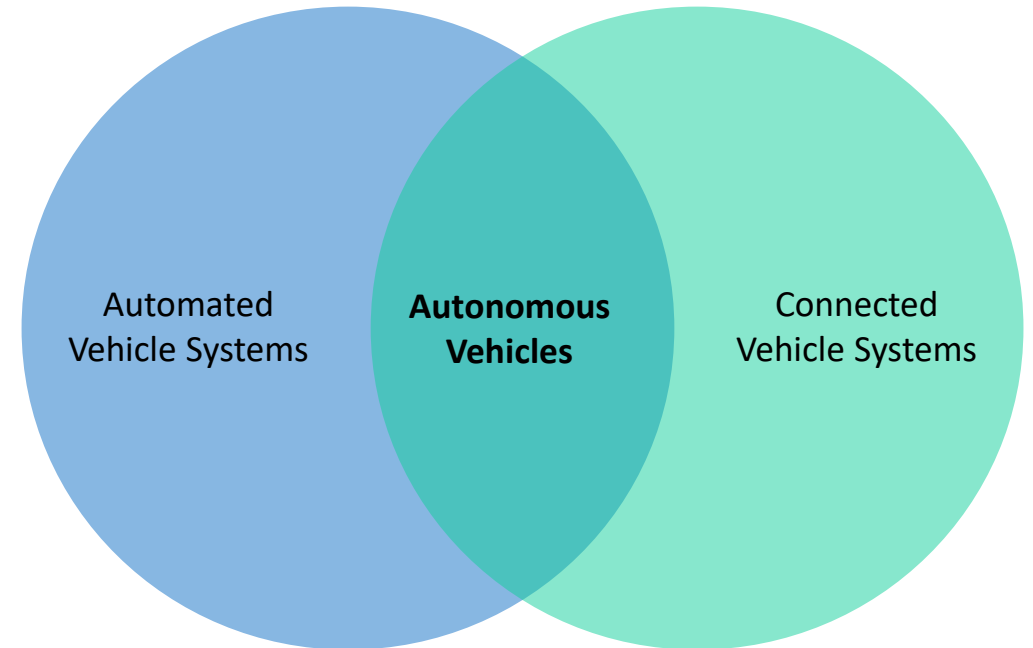
# Connected Vehicle Systems

# Connected and Automated Vehicle System Integration

Both automated and connected vehicle systems are necessary for autonomous vehicles.

## Connectivity is needed for:

- Trip requests
- Map and Software Updates
- Remote Assistance
- Live Traffic and Other Data for Dynamic Routing
- Vehicle Health Monitoring





# Electrification

Slow but steady adoption of electric vehicles due to:

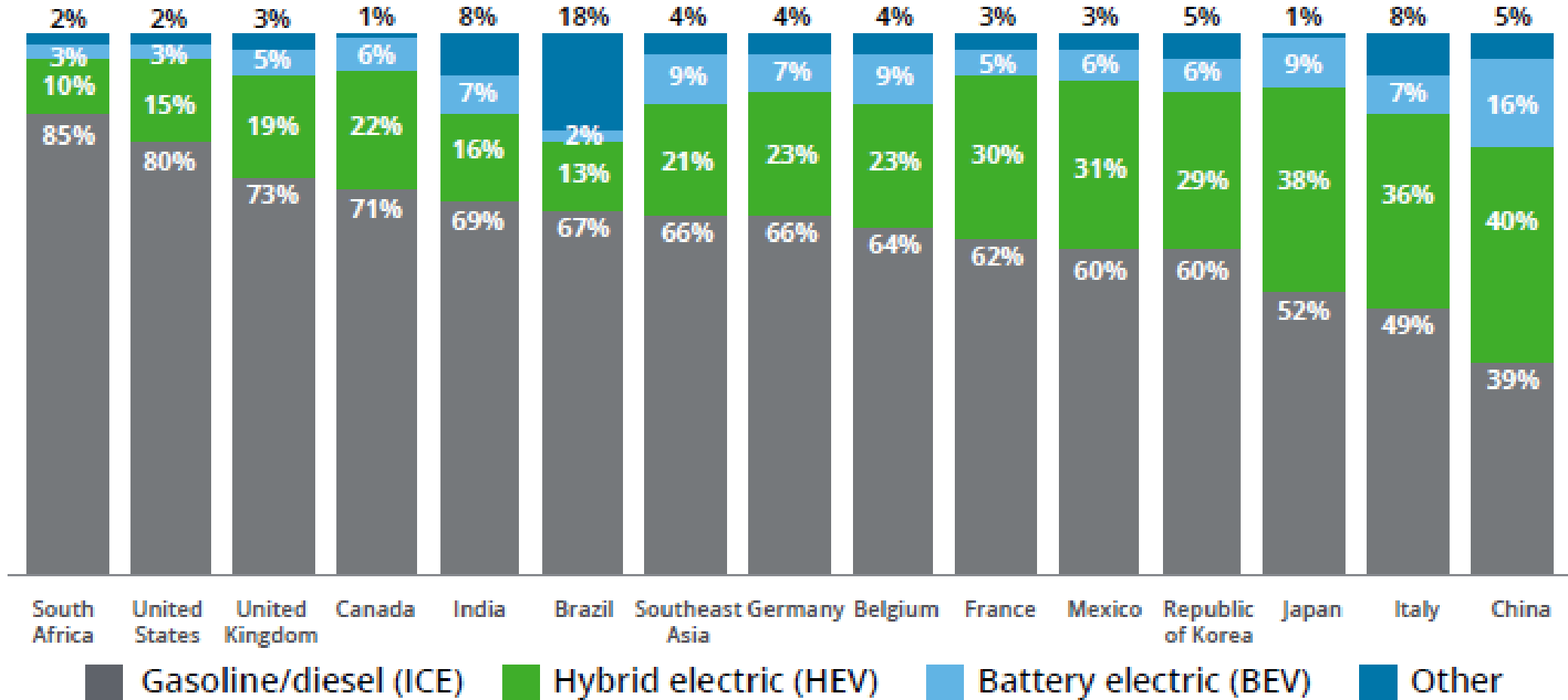
- Advanced battery technology
- Global efforts to reduce emissions
- Increased consumer interest

The electrification of the fleet will impact cities and regions:

- Demands on power grid
- New charging stations
- Decommissioning of gas stations
- Reduced gas tax revenue

Potential synergies with automation and connectivity

# Consumer Stated Preference for Next Vehicle, 2018



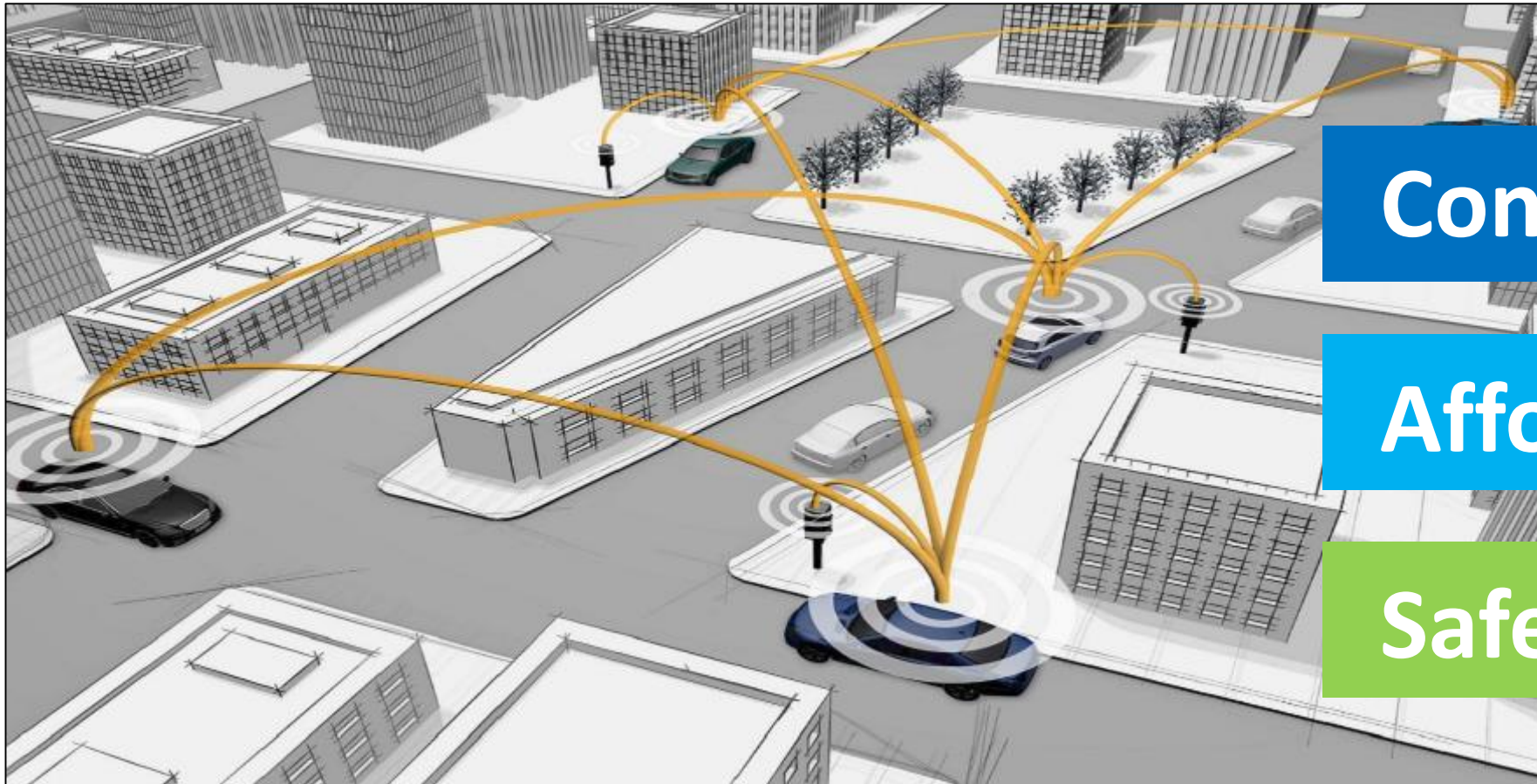
Note: 'Other' category includes ethanol, compressed natural gas, and hydrogen fuel cell.



# New Mobility Service Models

# Mobility

Not just *transportation*. It is *access* to transportation options that are:



**Convenient**

**Affordable**

**Safe**



# Why Mobility?

- Personal vehicles are expensive and inconvenient in urban areas.
- Urban areas designed to accommodate personal vehicles are restrictive towards other uses.
- Personal vehicles contribute substantially to negative health and environmental impacts.



# Why Mobility?

- Personal vehicles are parked 95% of the time on average
- Cruising to find open curb-side parking can contribute substantially to traffic congestion in urban areas
- Parking is among the lowest values of land-use in urban areas
- Urban parking subsidized through various means
- What else might be done with urban space now reserved for parked cars?

## The newest hot coworking space costs just \$2.25 an hour, because it is a parking spot

WePark shows that in cities like San Francisco, coworking is unaffordable to many, and the sheer volume of free space allocated to parked cars could be put to much better use.







# Mobility Services

- Changing customer relationships
- Packages suited to individual needs
- Disruption of product planning, development, and sales processes

RIDEHAILING



CARSHARING



RIDESHARING



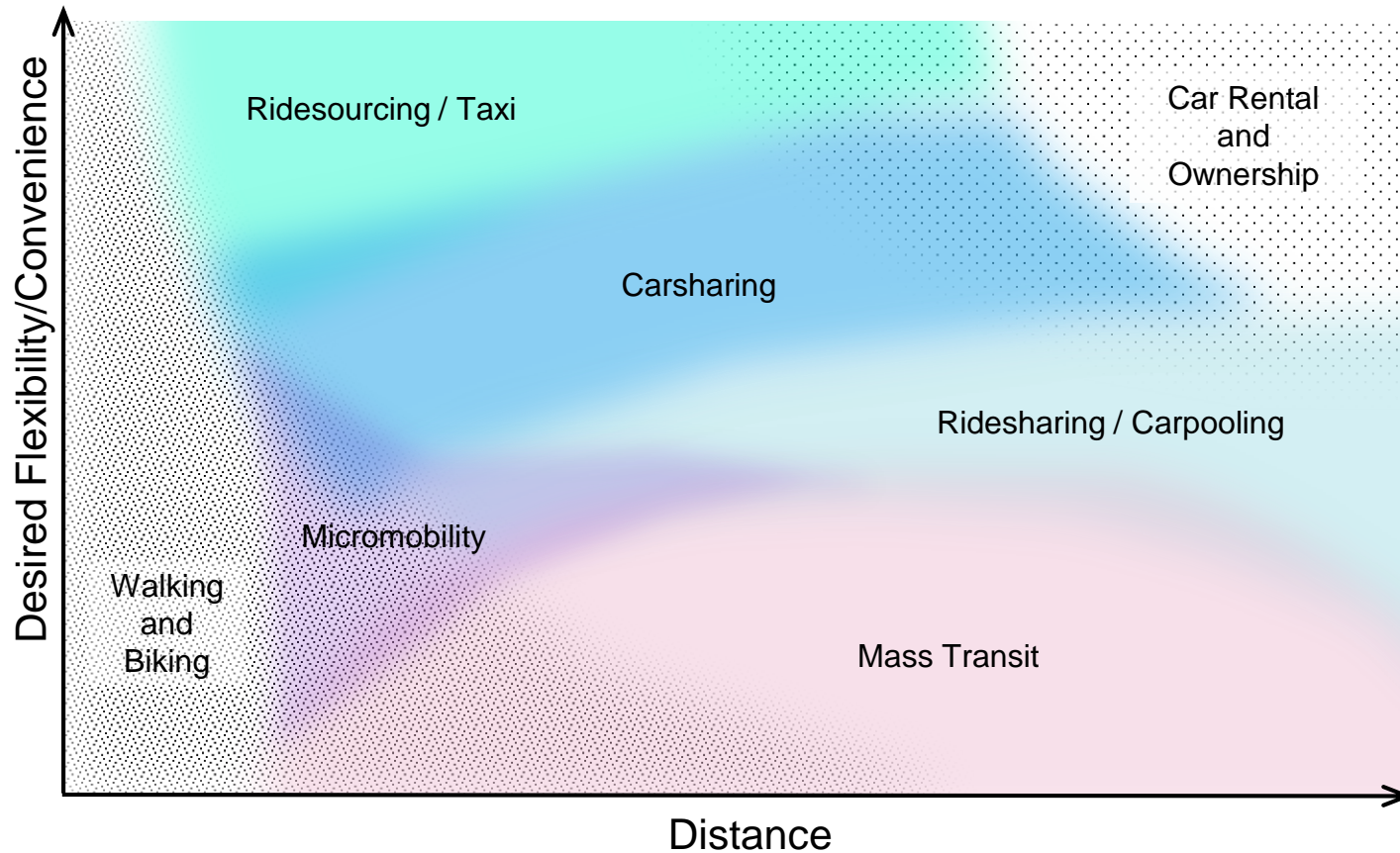
BIKESHARING

MICROTRANSIT



MOBILITY-AS-A-SERVICE

# Different Modes for Different Demands



**“MOBILITY-AS-A-SERVICE”**  
Envisions the integration of various modes within a single planning and payment platform.

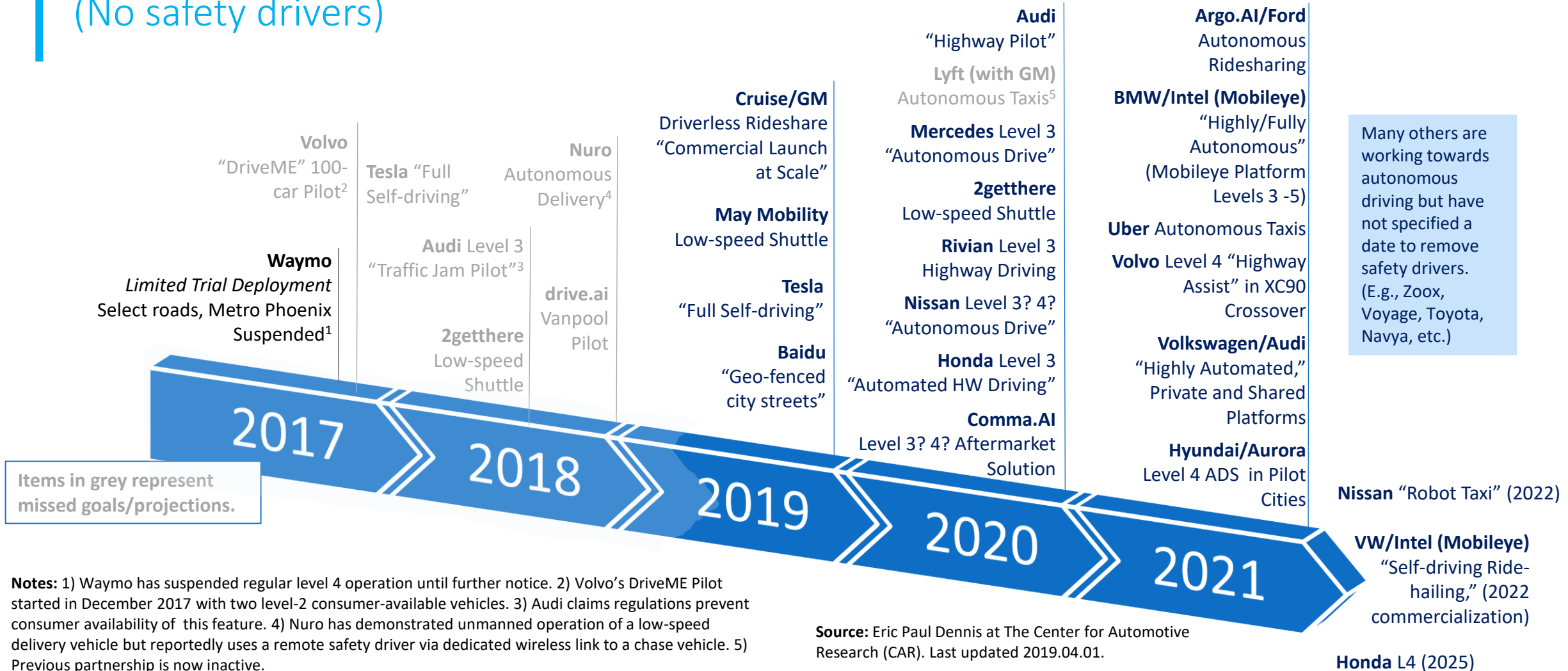




# Deployment and Adoption

# Announced Automated Vehicle Deployment Timeline

On-road Automated Driving Systems (SAE J3016 Level 4 unless otherwise noted)  
(No safety drivers)



# Path to Automated Vehicle Deployment

**Achieving unsupervised automated driving has proven difficult.**

Thus far, autonomous vehicle developers have been wary of removing operators from the vehicles/





# Slow Deployment of Autonomy

Truly driverless vehicles do exist today, but only with dedicated separated infrastructure.



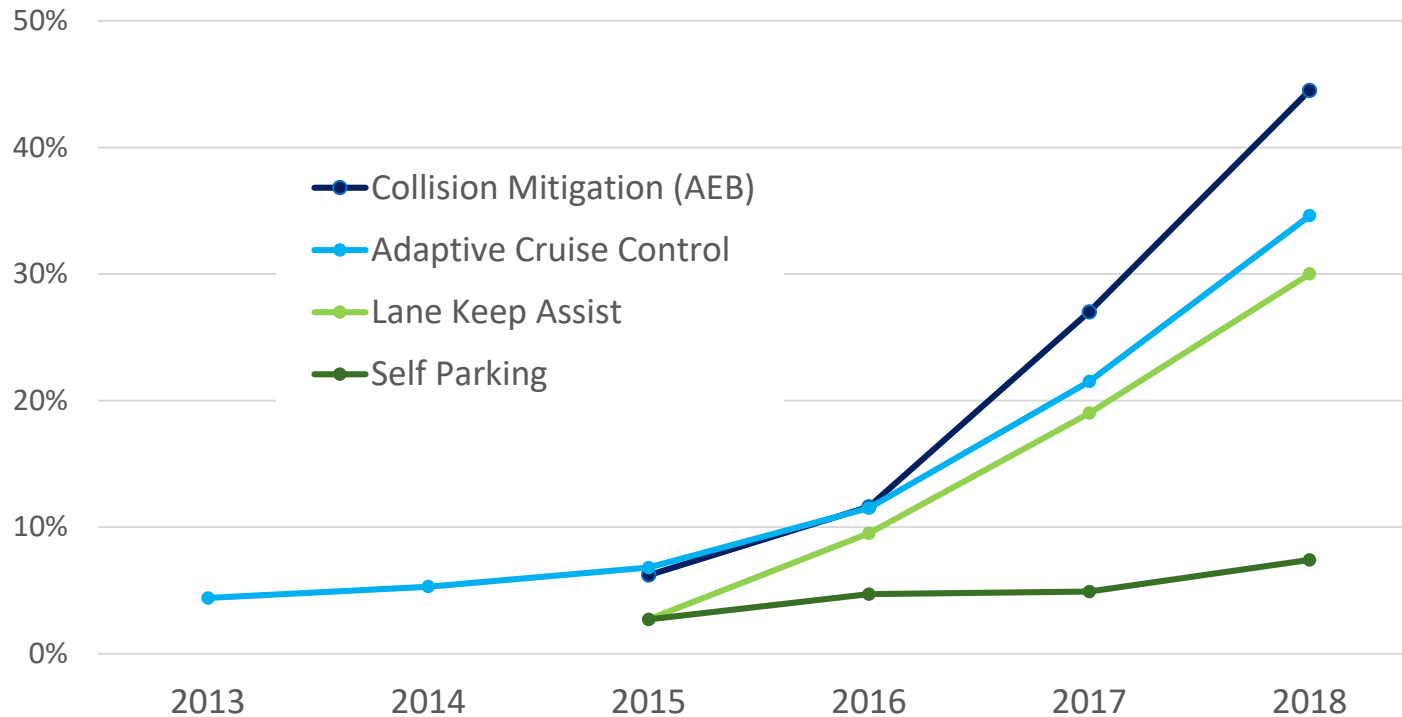
A driverless shuttle route – the Park Shuttle in the Netherlands. This shuttle service is scheduled to expand to include a route segment open to mixed-traffic in 2020.





# Automated Driver Assistance Uptake

U.S. Light Vehicle Fitment Rates, MY 2013 - 2018



## Rapid increase in fitment rates of automated driver assistance in recent years

- 44.5% of MY 2018 light vehicles included an automated emergency braking (AEB) system of some kind.
- AEB now standard equipment on some models, even mid-level models such as the Toyota Camry.
- Important to remember that AEB systems vary in performance and none are fully able to prevent all rear-end striking crashes

Source: Ward's Intelligence

# Connected Vehicles: Vehicle Data Monetization

## Many Opportunities, Many Challenges

- Standards and norms around data use and management continue to evolve
- Privacy concerns are emerging (e.g., EU GDPR)
- True value of data unclear
- New types of vehicle data continue to emerge
- Some hints at success, but no one has cracked this code

### AUTO OEMS

- Sell cars, after sales, financial services
- Package & sell features & service packages from service providers, start-ups & suppliers
- Analyze car data & leverage insights

### 'HIGH-TECH GIANTS'

- Provide & operate IT backbone (analyze/sell data from multiple environments (incl. car) to sell advertisement)
- Provide features/applications building on smart-phone platforms

### AUTO SUPPLIERS

- Provide software/hardware parts & infrastructure
- Provide features/applications
- Perform & sell car data analytics

### SERVICE PROVIDERS (& START-UPS)

- Develop new applications, features & services
- Combine car data with other sources or services to resell packages

### RETAILERS & SERVICE CHAINS

- Push advertising & services (used in cars)

### MOBILITY PROVIDERS

- Offer car sharing/e-hailing/rental services
- Provide public transportation

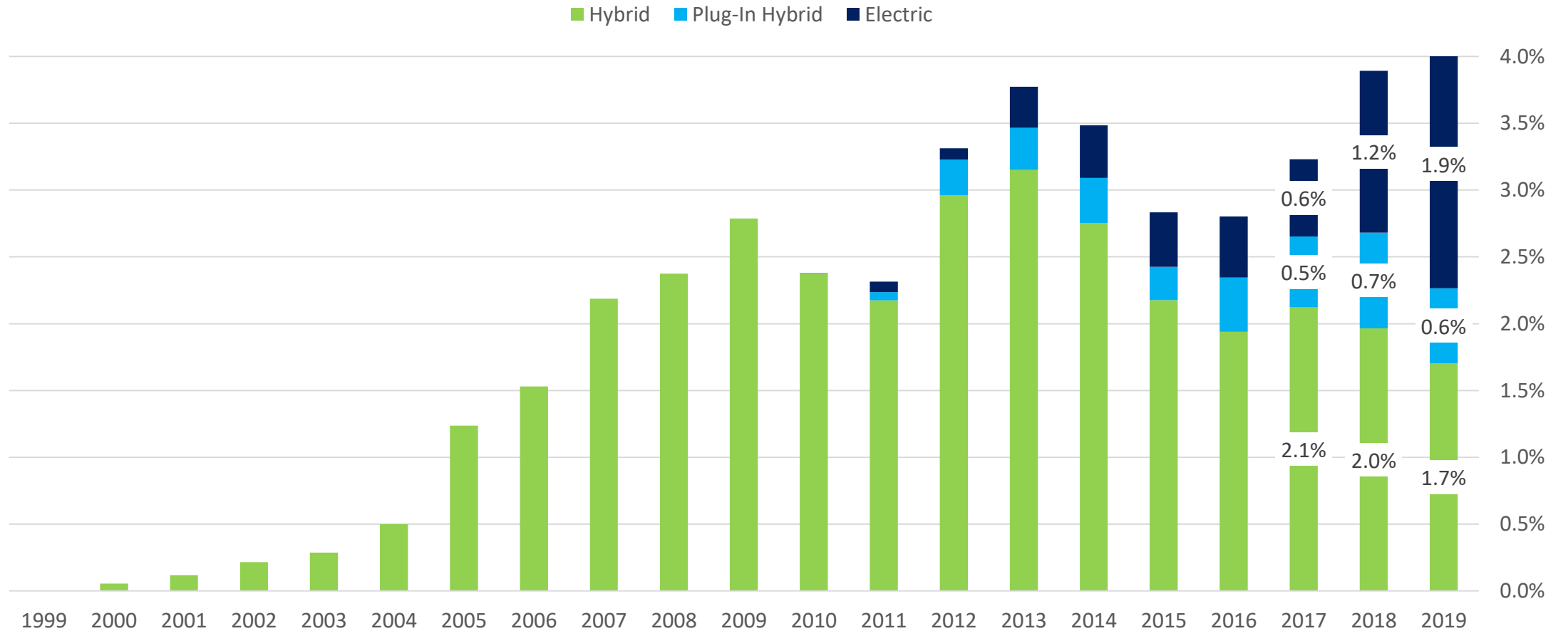


Image: Verhaert

# Electrification

## U.S. Electrified Light Vehicle Sales by Propulsion Technology

1999 – 2019 YTD Through February



Note: Electrified vehicles consist of BEV, HEV and PHEV

# New Mobility Services

- Much excitement and experimentation
- Much uncertainty
- Evolving expectations

RIDEHAILING



CARSHARING



RIDESHARING

CARSHARING



BIKESHARING

MICROTRANSIT



MOBILITY-  
AS-A-  
SERVICE



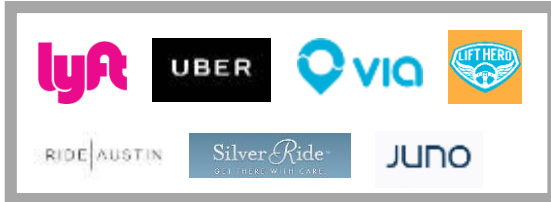


## Transition Away from Personal Vehicles

- Multimodal integrated payment and trip planning
- Dedicated pick-up and drop-off locations for shared vehicles
- Adoption of electric vehicles
- New options for public and shared transit

# Mobility Services in North America

## Ridesourcing



## Pooled rides and ridesharing



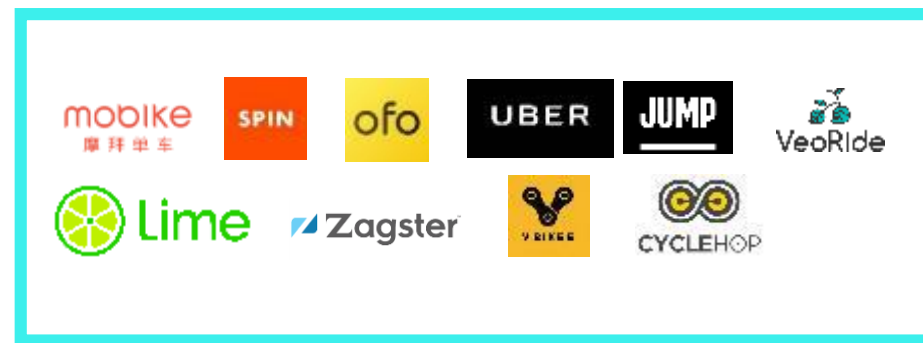
## Microtransit



## Bikesharing (stationed)



## Bikesharing (dockless)



## Scooter sharing



## Carsharing (round trip)



## Carsharing (free floating)



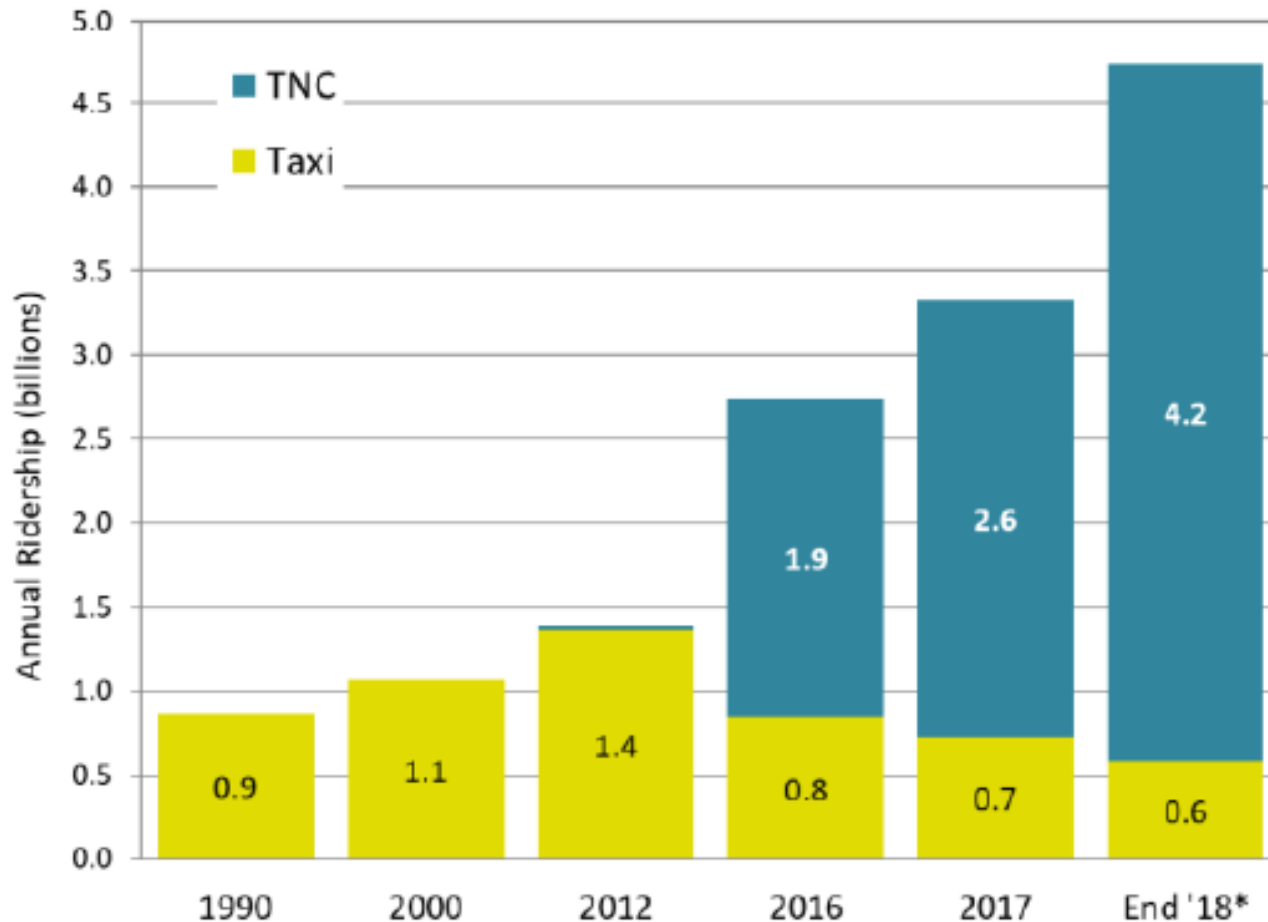
## Carsharing (P2P)



# Growth of Ridehailing/Ridesourcing



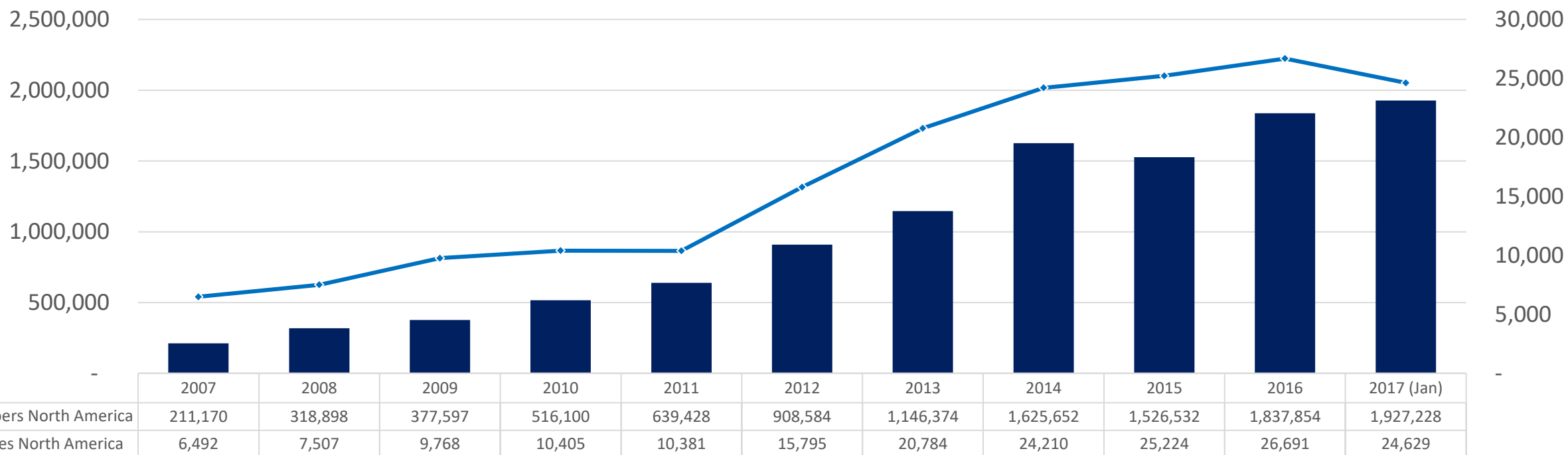
TNC and taxi ridership in the U.S., 1990-2018



- Links passengers with drivers via a digital platform
- Does not typically own the vehicles used to provide the service
- Service provided has been defined as “ridesourcing” by SAE J3163. This is similar but distinct from “ridehailing” services provided by traditional taxi companies.
- TNCs expanded in an era of light regulation. As local governments respond to expansion of services and implications, TNC business models may be under pressure.

Source: Bruce Schaller, 2018

# Growth of North American Carsharing Programs



Source: Shaheen, S., Cohen, A., Jaffee, M (2018). *Innovative Mobility: Carsharing Outlook*, Transportation Sustainability Research Center, University of California, Berkeley.



# Mobility as a (Subsidized) Service

Industries are beginning to partner with mobility service providers to improve the experience of customers, clients, and employees.

Medical patient mobility



Campus Circulators

Employee Shuttles



Retail and grocery partnerships





Automated  
Connected  
Electric  
Shared



# Thank you for your attention.

Valerie Sathe Brugeman

Assistant Director, Center for Automotive Research

[vsbrugeman@cargroup.org](mailto:vsbrugeman@cargroup.org)



## RESEARCH

Independent research and analysis on critical issues facing the industry.



## EVENTS

Industry-driven events and conferences that deliver content, context, and connections.



## CONNECTION

Consortia that bring together industry stakeholders for working groups, networking opportunities, and access to CAR staff.