CENTER FOR AUTOMOTIVE RESEARCH

Mobility *is* Economic Development

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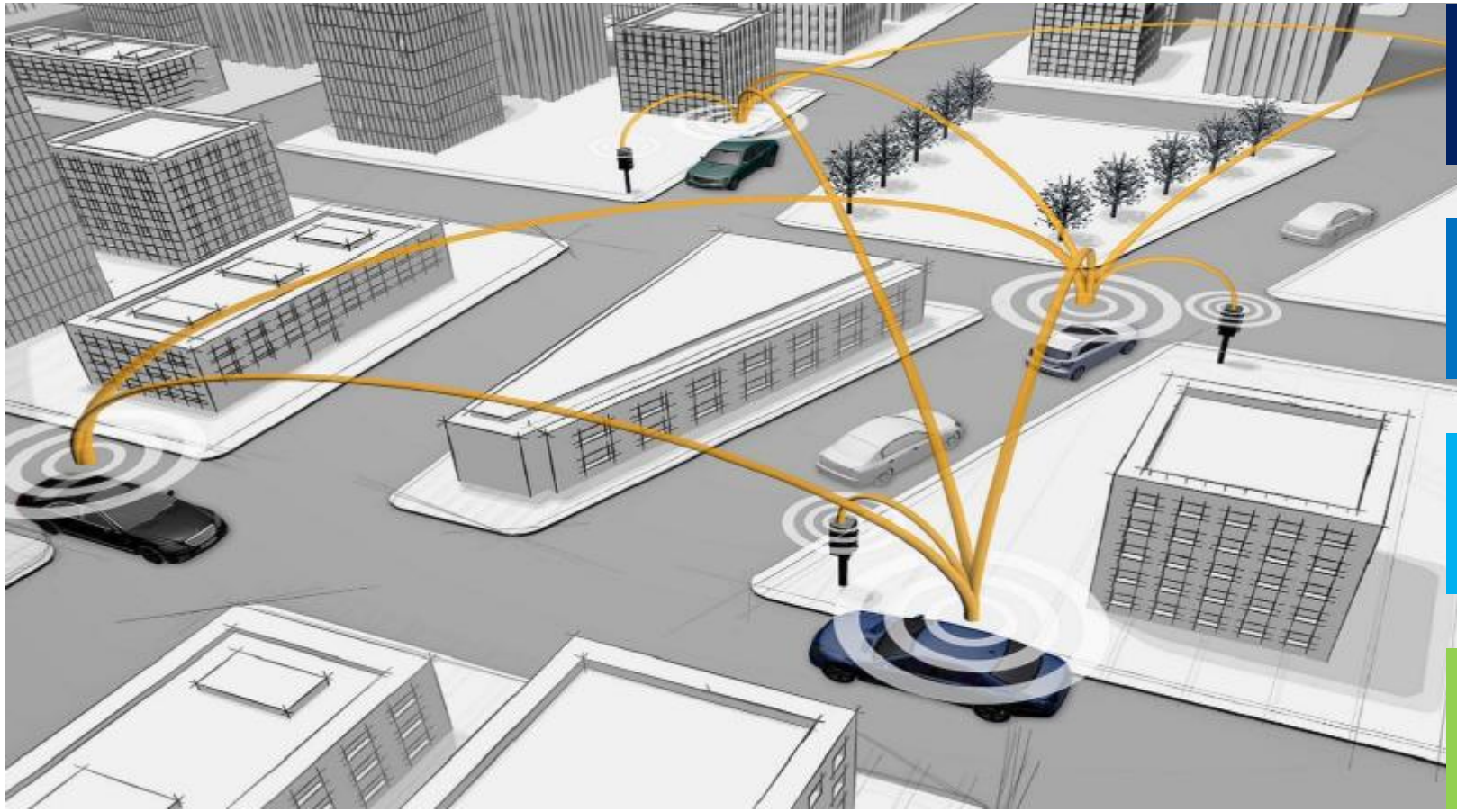
Mobility:

The movement of people and goods from place to place, job to job, or one social level to another (across bridges – physical or assumed).

Smart Mobility:

the movement of people and goods with…



TRIPLE ZERO

0 Accidents & Fatalities

0 Carbon Footprint

0 Stress

A Smart City …

… uses data and technology to improve metrics that reflect a city's values.

Transition Away from Personal Vehicles

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

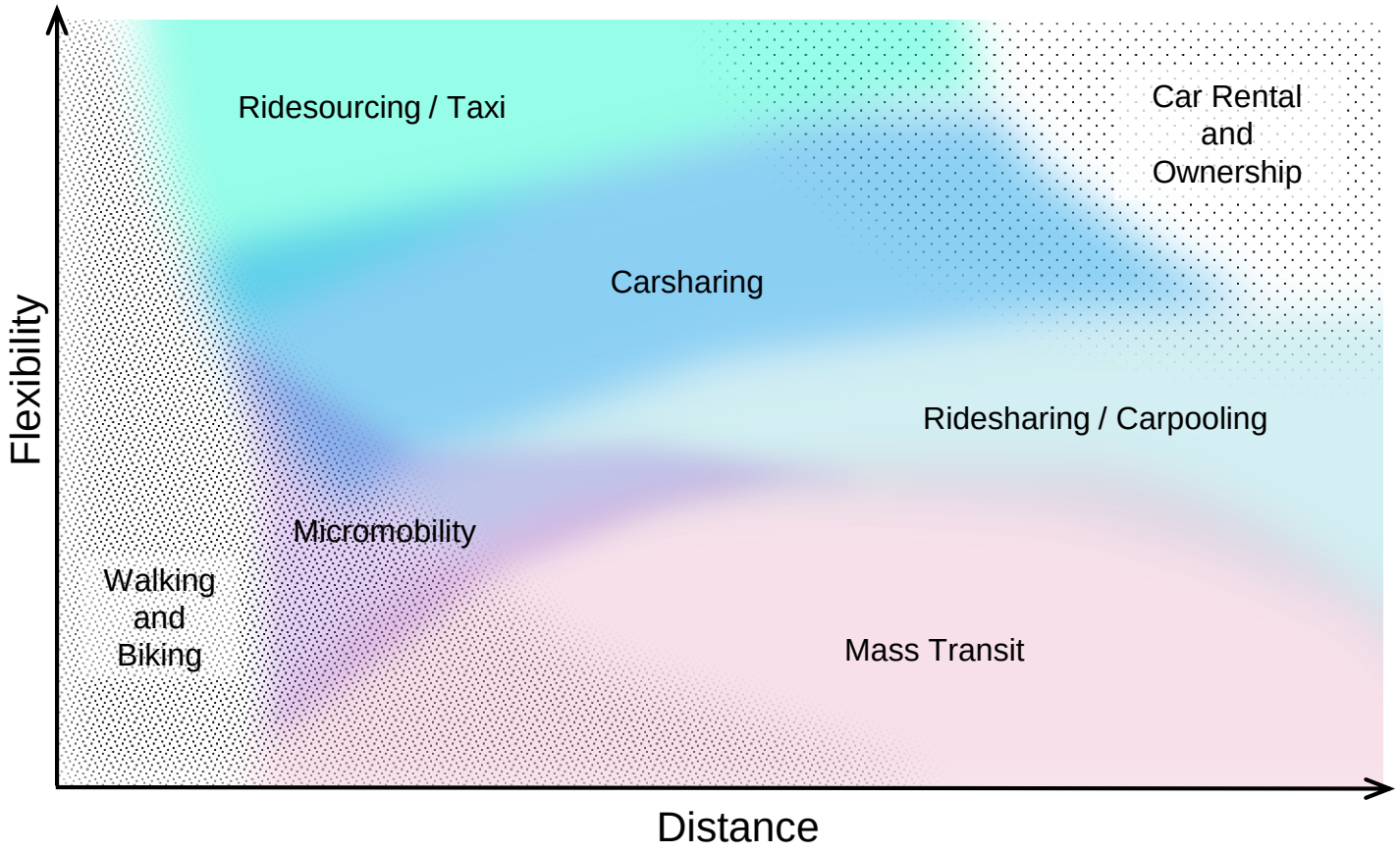
Common Payment Systems

Multi-Modal Trip Planning Application

Integrated Common Payment System

Inclusive Mobility

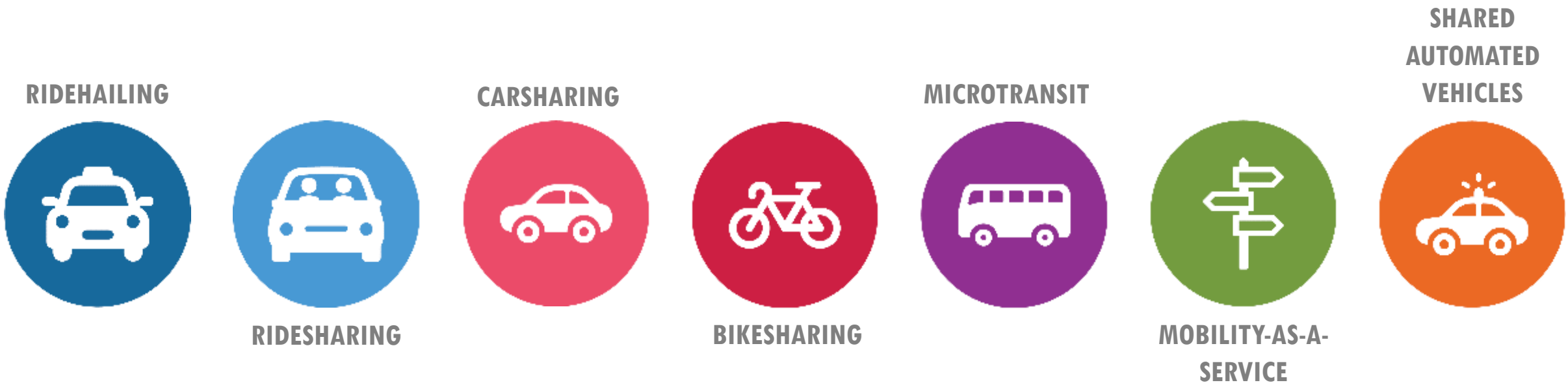
Different Modes for Different Demands



Smart mobility envisions integrated modes, each with its own purpose.

Innovative Mobility Services
Business models

Innovative mobility services are transportation solutions enabled by emerging technologies and wireless connectivity that allow for more convenient, efficient, and flexible travel.



Elimination of the Personal Vehicle “Security Blanket”

Multimodal Integrated Payment & Trip Planning

Shared pick-up and drop-off vehicles

Electric Vehicle Adoption

New Public Transit Options

Personal Vehicle Utilization

Mobility services can better utilize resources

- 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?

Shared Mobility Services in North America

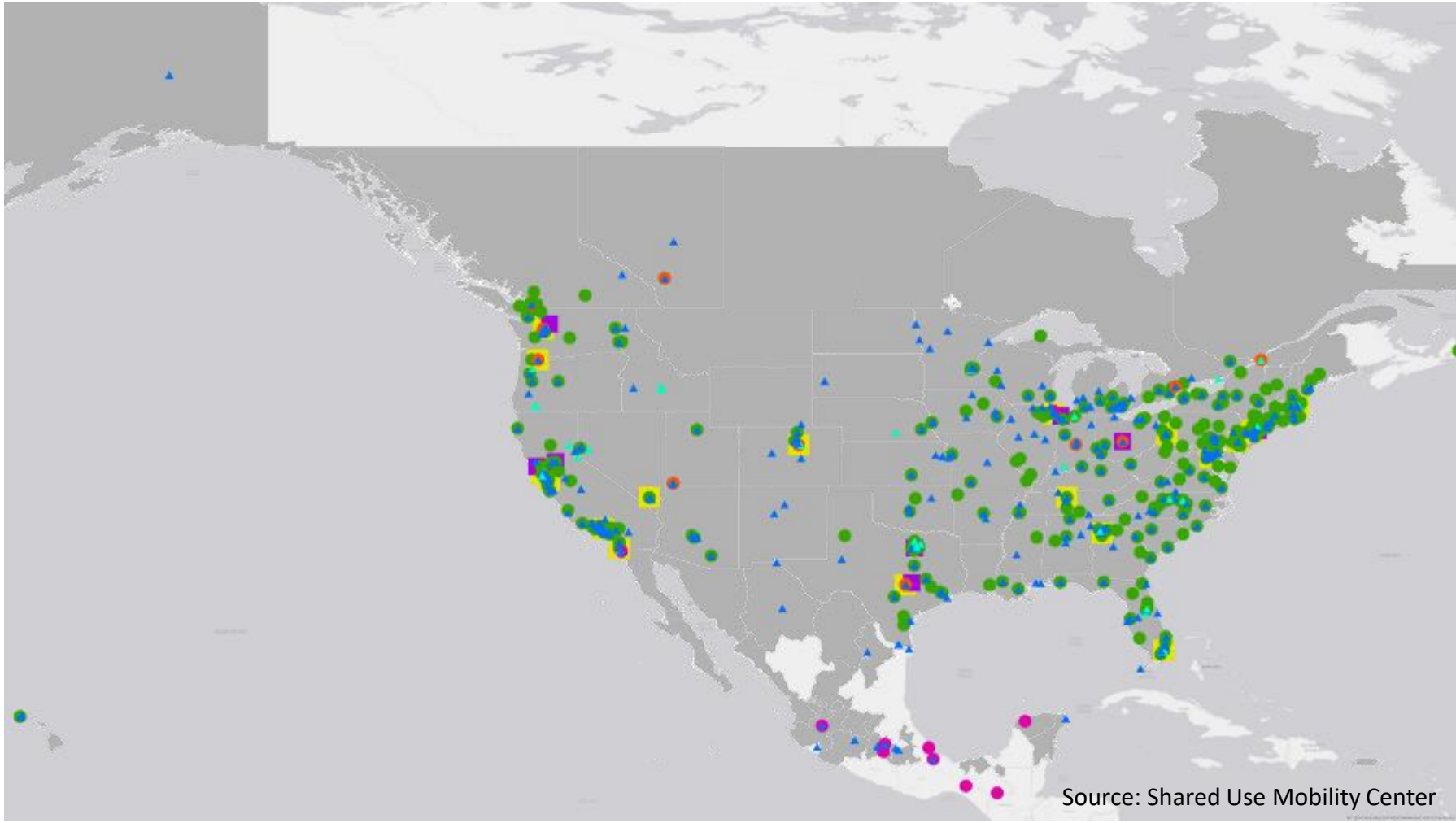
600+ cities with ridesourcing

20+ cities with pooled rides

10+ cities with microtransit

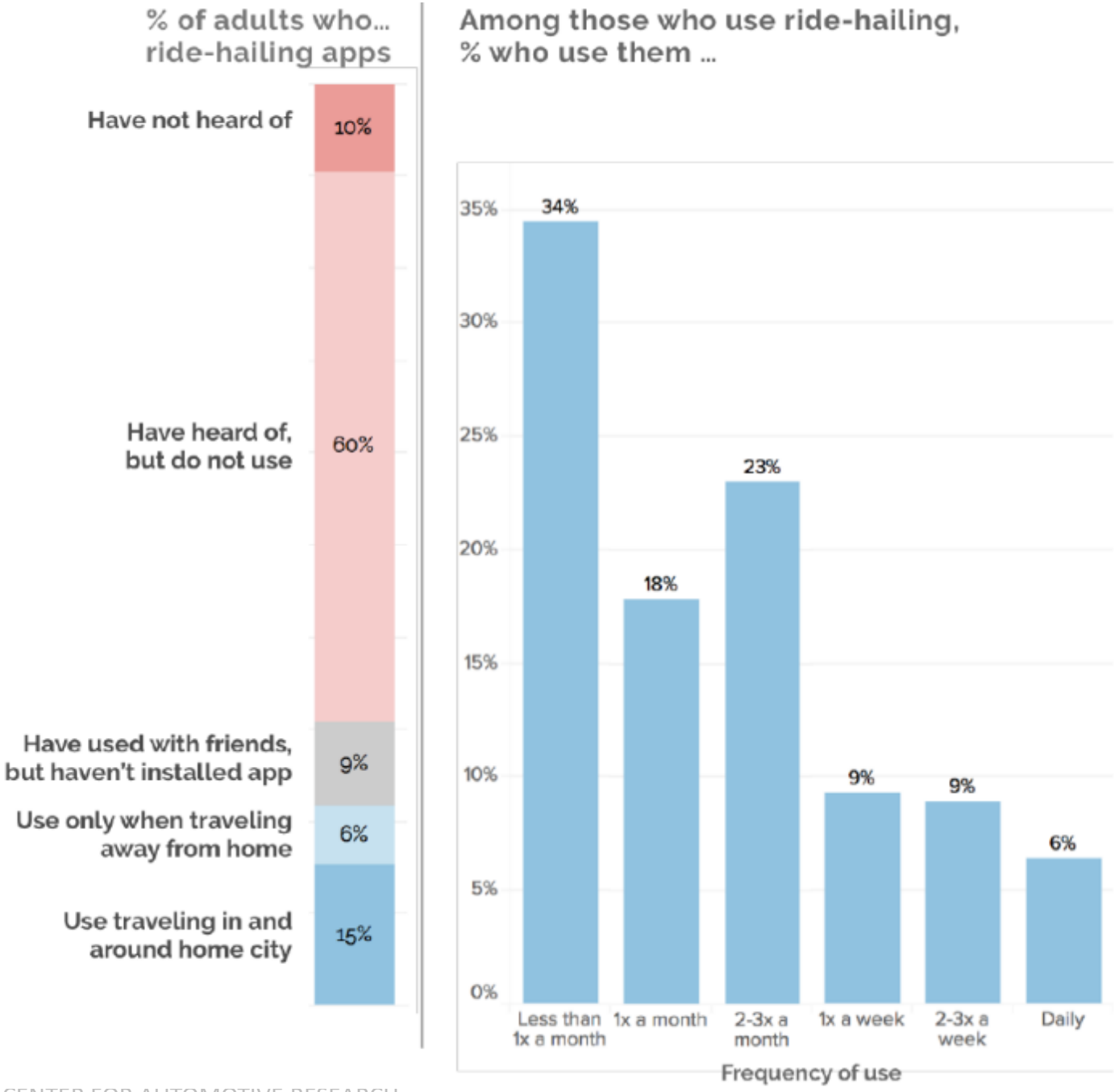
400+ cities with carshare (round trip, free floating, P2P)

400+ cities with bikeshare (stationed, dockless) & scooters



Source: Shared Use Mobility Center

Ridesourcing Adoption



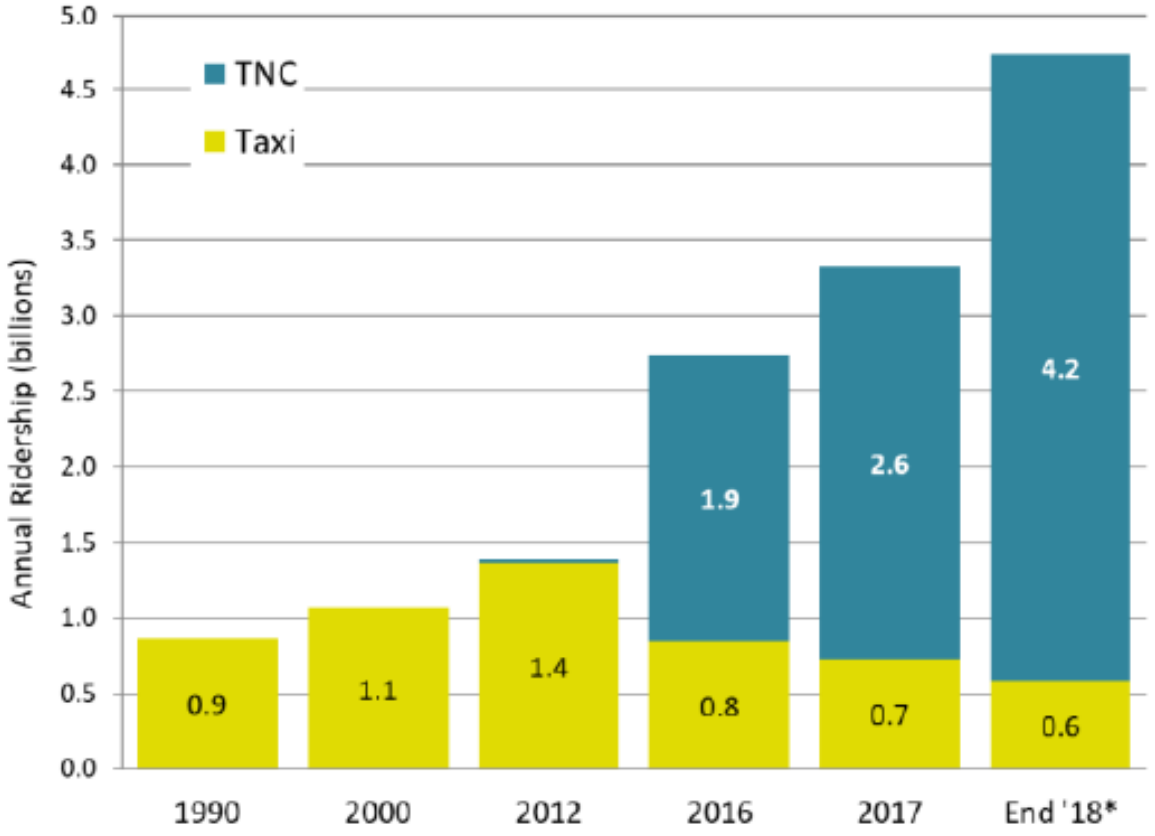
Adoption and Utilization of Ridesourcing in Major U.S. Metropolitan Areas

Source: Clewlow, Regina R. and Gouri Shankar Mishra (2017). *Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States,* UC Davis

Ridesourcing (Transportation Network Companies)

Problem or Solution?

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



Bad news:
Emerging evidence suggests TNCs tend to increase VMT, increase vehicle ownership rates, and reduce use of public transit.

Good news:
Data varies by city. This suggests that in the right context, with the right policies, TNCs can be part of a strategy to reducing VMT and GHG.

Source: Schaller 2018

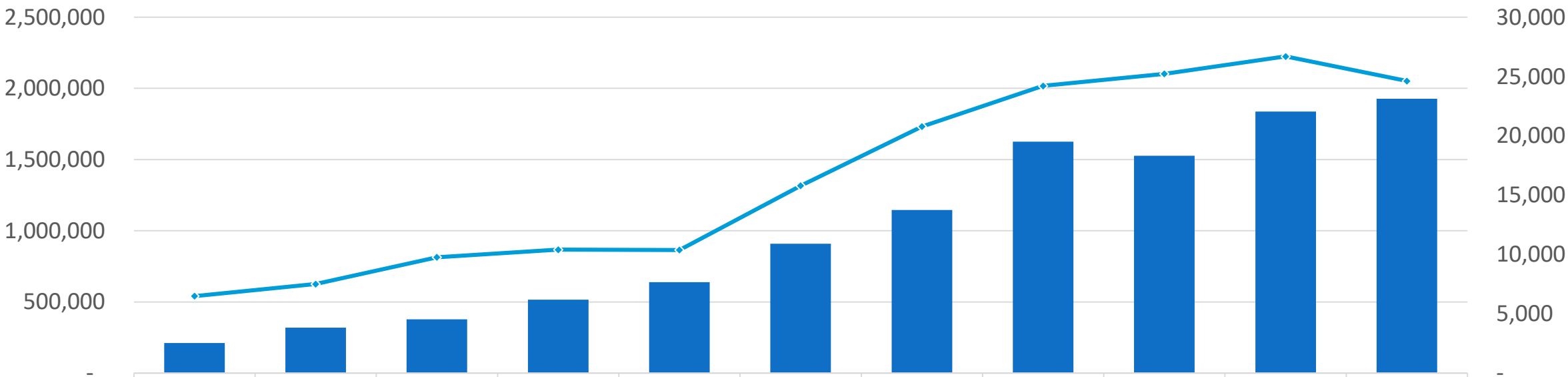
U.S. Innovative Mobility Services Projections

- From 2015 to 2030, total miles traveled rise from roughly 3 trillion to almost 5 trillion

- Of those miles, about 4% are shared in 2015 and will grow to 25% in 2030

Source: CAR Research, UC Berkeley

Growth of North American Carsharing Programs



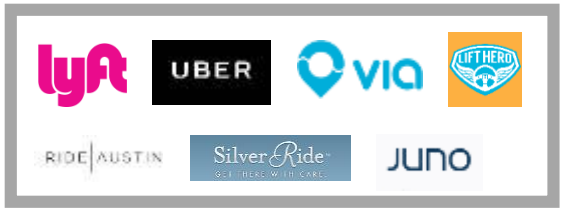
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017 (Jan)
Members North America	211,170	318,898	377,597	516,100	639,428	908,584	1,146,374	1,625,652	1,526,532	1,837,854	1,927,228
Vehicles North America	6,492	7,507	9,768	10,405	10,381	15,795	20,784	24,210	25,224	26,691	24,629

Yearly data represents July numbers, unless otherwise specified. Totals include one-way and round-trip carsharing and exclude P2P programs. Proxies were used for five of the 32 round-trip operators.

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

Shared Mobility Services in North America

Ridesourcing

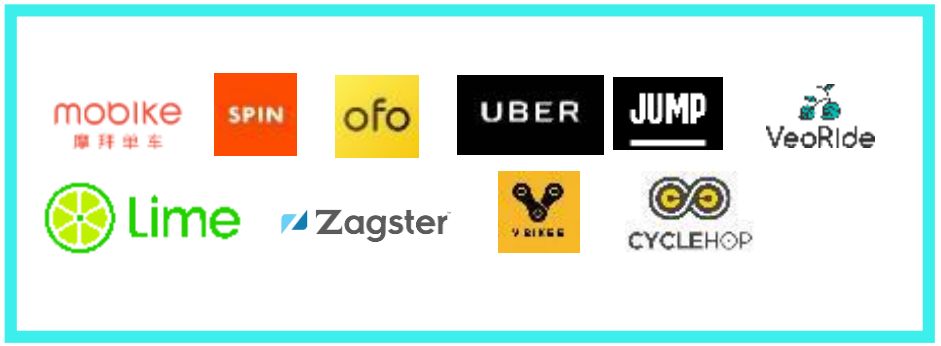


Pooled rides and ridesharing

Microtransit

Bikesharing (stationed)

Bikesharing (dockless)



Scooter sharing

Carsharing (round trip)

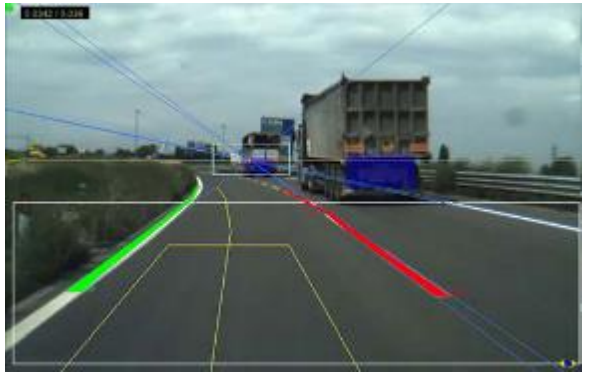
Carsharing (free floating)

Carsharing (P2P)

Source: Shared Use Mobility Center, CAR research

Modifications to Existing infrastructure
Signals and Road Markings

- Traffic signal updates are necessary to enable V2I
- V2I communication may replace some functions of signs and signals
  - Pedestrians, cyclists, or non-connected vehicles still need them
- Clear lane markings are beneficial, but not necessary



Source: Point Grey

Land form
sprawl

Decrease ← Sprawl → **Increase**

- Urban-core space could be freed up for redevelopment, thanks to lower parking demand
- Denser, more walkable developments could be created

Source: Alloybuild

- Willingness to travel longer distances to and from work could increase
- Household and businesses might locate farther from urban cores

Transformation of Parking

CAVs will enable more efficient use of existing parking su

Opportunities

- Reduced need for new municipal parking
- Smaller parking spots, less on-site and on-street parking
- Parking relocated on the back of lots or outside prime locations

Considerations

- Possible decline of municipal revenues
- Reconversion in drop-off/pick-up areas
- Relocation of CAV parking impacts both VMT and congestion

Travel demand and vehicle miles traveled (VMT)

- Lower car ownership
- Pay-per-use programs discourage unnecessary travel
- Increased vehicle occupancy
- First-and-last-mile solution with transit
- Overall lower number of vehicles
- Less travel related to searching for parking
- Denser land development (less parking)

- Increased travel demand
- Zero occupancy travel
- Reduced trip chaining
- Mode shift away from mass transit
- Greater urban sprawl
- Significant share of privately owned cars
- Increased mobility of non-drivers
- Increased automated freight and delivery

Implications for Mass Transit

Opportunities

Considerations

Private or shared CAVs

- Could offer better first- and last-mile connections

- May reduce public transit demand
- Could negate the congestion benefits
- Might exacerbate equity issues and digital divide

Automated transit

- Could be more affordable
- Improves service in low-density areas
- Feeder service to rail or BRT
- Could decrease wait times
- Pilot projects already exist

- Could lead to job loss among public transit employees

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Amazon HQ2 Site Selection

Over 200 cities responded to Amazon's RFQ to host its HQ2 location. Over half of these offered generous incentives. But few could offer the on-site access to mass transit that Amazon stated as a core preference.

While overall trends in home-ownership and vehicle use are fairly stable, entry-level knowledge industry workers, on which tech companies rely, highly prefer dense urban settings with reliable frequent transit options.

The following is a summary of the Project's ideal site and building requirements:

Core Preferences	***Quantity***	***Units***	***Description***
Site Requirements			
Proximity to population center	30	Miles	
Proximity to International airport	Within approx. 45	Minutes	
Proximity to major highways and arterial roads	Not more than 1-2	Miles	Close to major arterial roads to provide optimal access
Access to mass transit	At site		Direct access to rail, train, subway/metro, bus routes
Building Requirements			

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

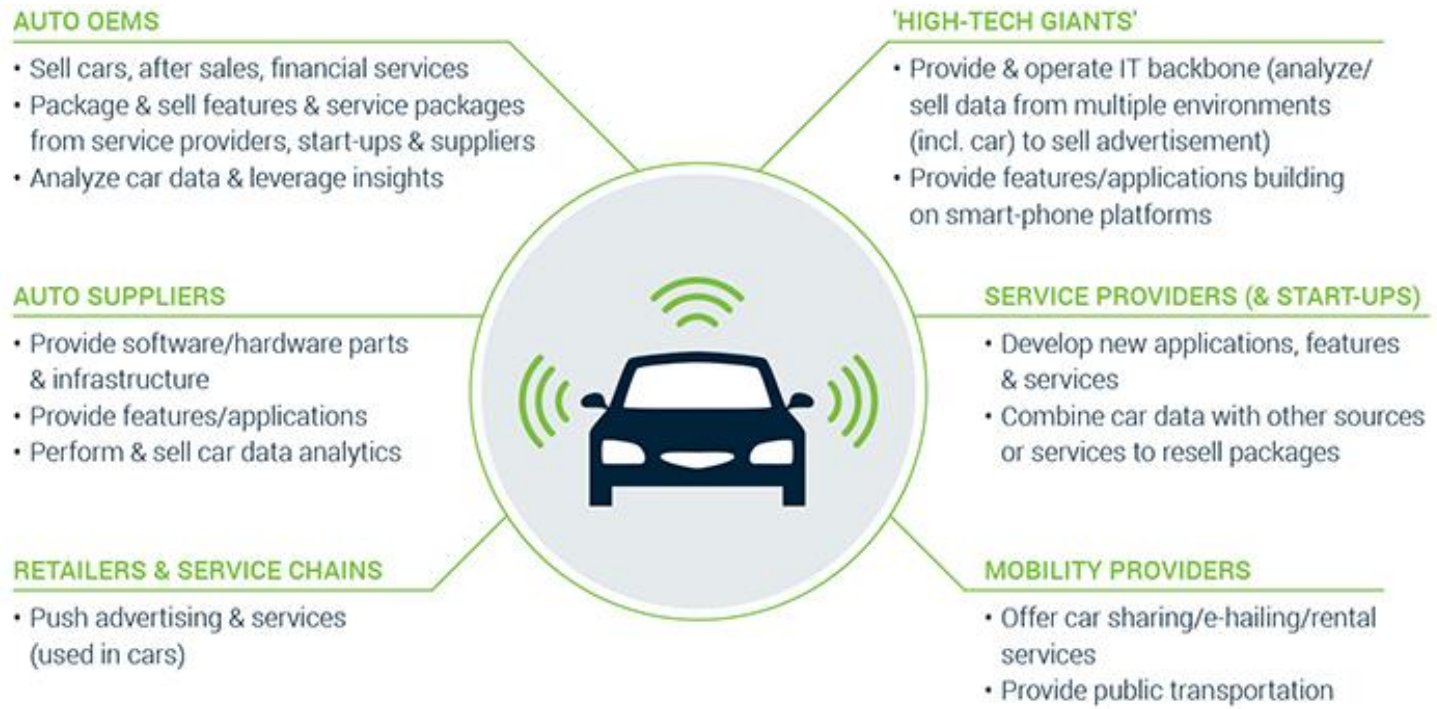

Image: Verhaert

Mobility as a (Subsidized) Service

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

Medical patient mobility

Campus Circulators

Retail and grocery partnerships

Employee Shuttles

Automated, Connected and Electric and Shared Mobility

Driving the future

Shared

Ride-hailing; Ride-sharing; Car-sharing,

Automated

From automated driver assist systems to robo-taxis, technology is leading to a change in who is driving

Electrified

The BEV is an enabling technology for shifting how we view mobility

Connected

Vehicle to Vehicle; Vehicle to Infrastructure; and Vehicle to Cloud is coming

Intelligent Vehicles & Mobility

TODAY

- Active safety systems such as ESC, forward collision warning, lane departure
- SAE Level 1-2 available
- 4% of global VMT are shared
- New concepts, services & companies

2020

- Advanced driver assistance (ADAS) on all new vehicles
- V2V emerging—DSRC and/or 5G
- Wide deployment of Level 2; first Level 4 available in limited release (shuttles, robotaxis)
- 6.5% of global VMT are shared
- New mobility services spread beyond cities

2025

- Greater deployment of Level 4 (commercial trucks)
- Wider availability of V2V and V2I communication
- 11.7% of global VMT are shared
- Vehicle sharing becomes a more viable alternative to ownership

2030

- Worldwide adoption of Level 4 shuttles, robotaxis, commercial vehicles
- Level 4 available on personal vehicles
- Full availability of V2V; expanded V2I
- 26.2% of global VMT are shared
- New mobility services in rural areas

Interaction with Non-Motorized Traffic

Opportunities

- Automated driving promises increased safety for pedestrians and cyclists.
- AVs can free up space for pedestrian areas and bike lanes (through road diets).

Considerations

- AVs need to learn the implicit and explicit cues of pedestrians and cyclists and *vice versa*.
- Non-motorized transportation networks could become even more fragmented, especially in urban settings.

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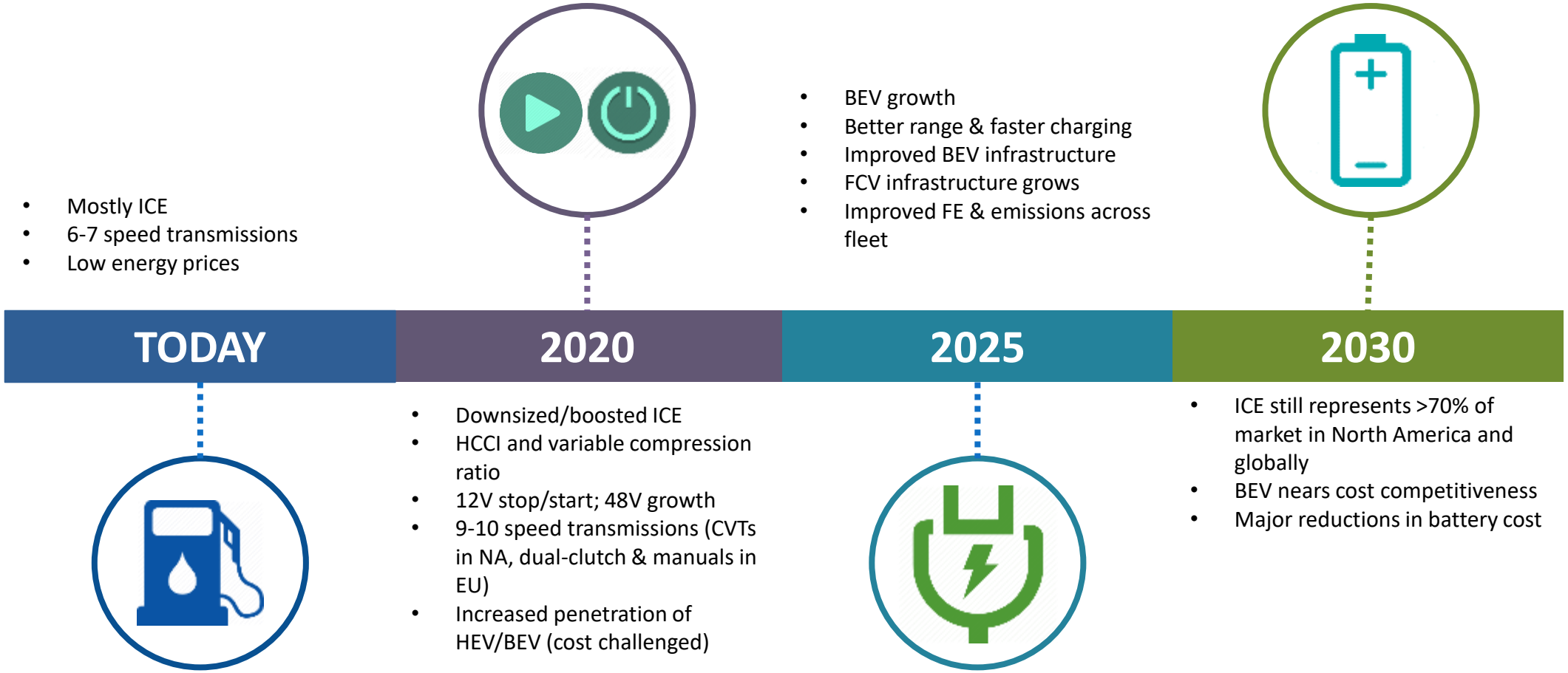
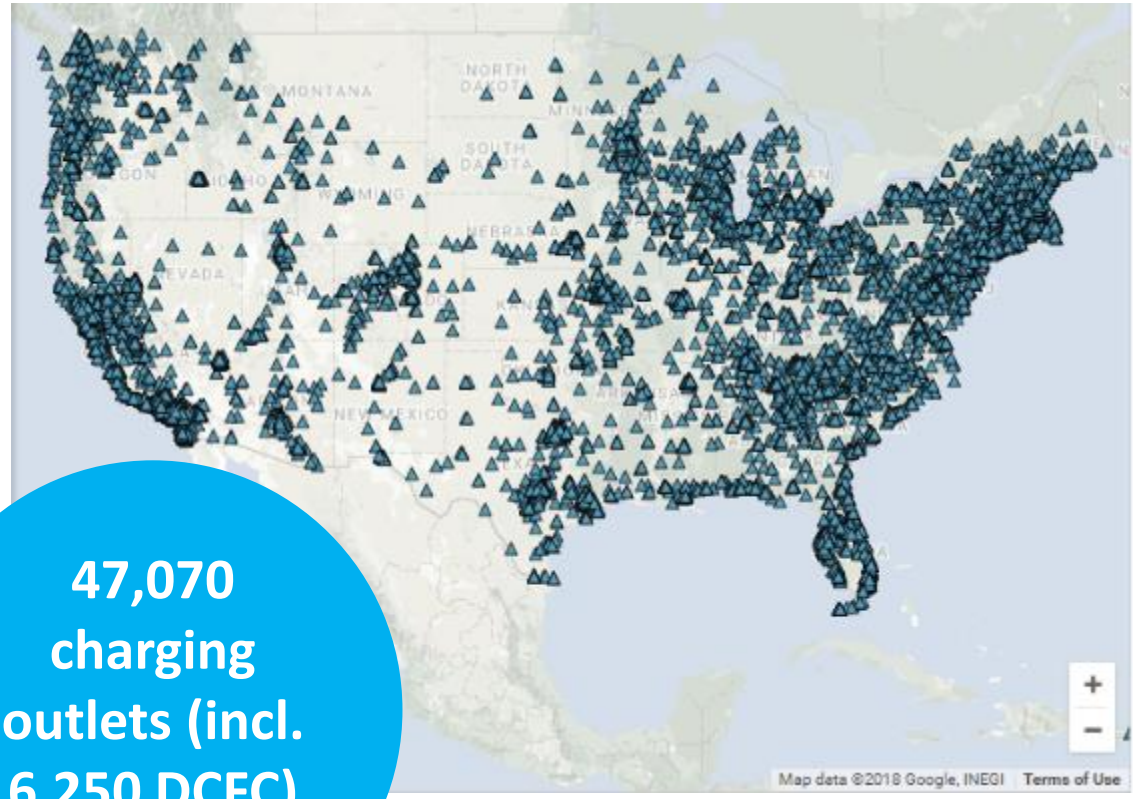
Powertrain, Propulsion & Energy Storage



U.S. Electric Vehicle Charging Infrastructure



47,070 charging outlets (incl. 6,250 DCFC)

Source: Alternative Fueling Station Locator, January 2018

Public Charging Needed (2030)

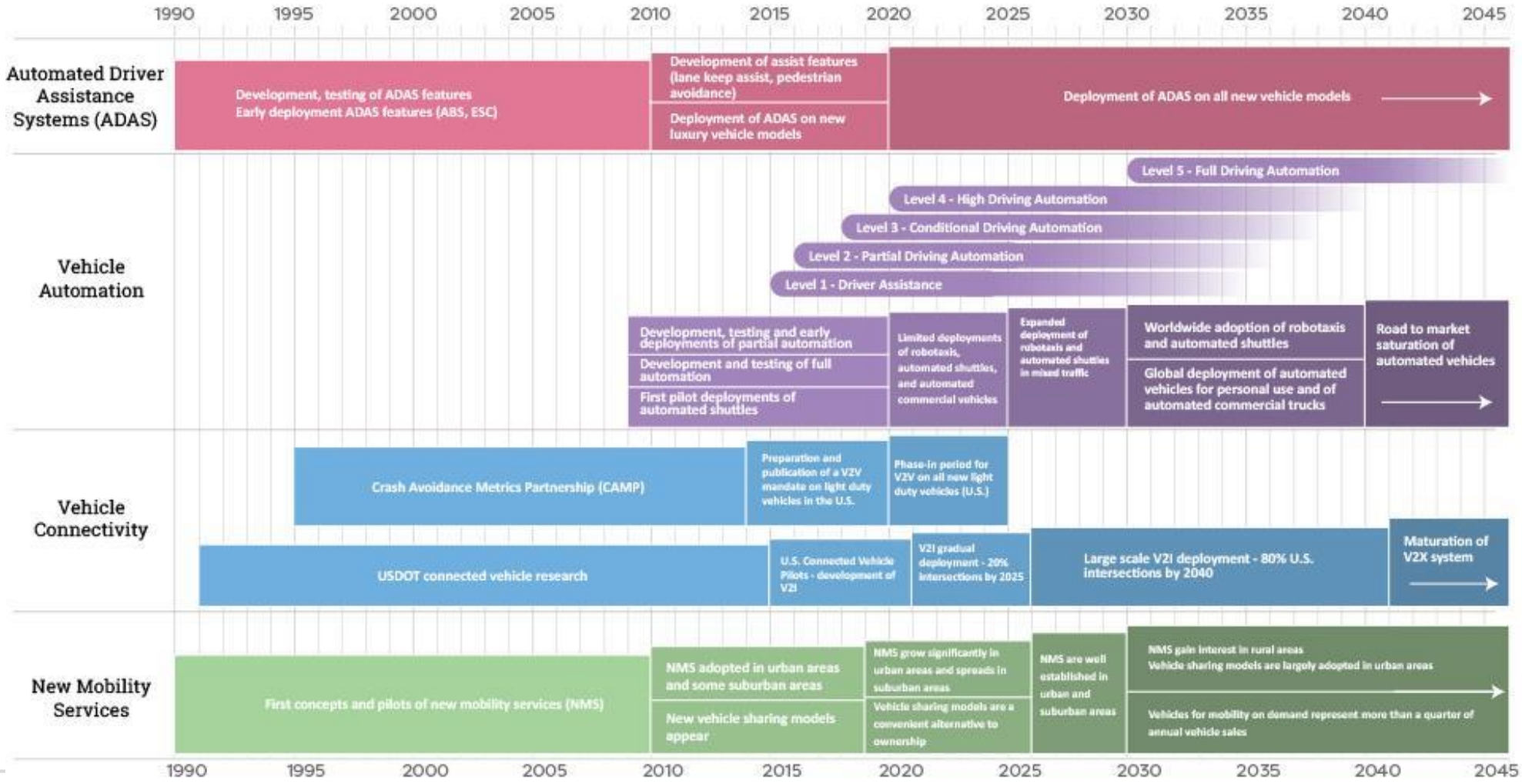
- 27,500 DCFC outlets
- 601,000 non-res L2 outlets

2030 Scenario

- Stock of 15 million EVs
- 88% home charging
- Current daily driving patters: 70% driving < 40 mi; 95% < 100 mi

Source: National Plug-in Electric Vehicle Infrastructure Analysis, DoE, September 2017

Intelligent Mobility Technologies
Global General Evolution Timeline, 1990 to beyond 2040



Source: CAR Research

Thank you for your attention.

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RESEARCH

Independent research and analysis on critical issues facing the industry.

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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.