Behavior, Energy and Climate Change

Towards Energy Efficient and Shared Mobility Services

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Clement Rames

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Session 1D: The Future of Mobility, October 16, 2017

Outline

- Define & introduce shared mobility services

- Zoom in on 3 cities: modal share, urban form

- Energy impacts – back of the envelope calculations

- Moving the needle on shared mobility – key takeaways

Motivation

- Environment: fossil-fuel dependence, greenhouse gas emissions

- Public health: air quality issues, stress, road safety

- Equity: access to transit, jobs, education, healthcare

- Cost: traffic congestion, parking, car ownership

Photo credit: Odyssey

Bringing Sharing to the Center Stage

- Electric vehicles taking off

- Self-driving cars on-road testing

- Use TNCs as an analogy to study impacts of self-diving cars (shared, autonomous fleet)

- Look beyond U.S. borders: sharing is much more prevalent in other parts of the world
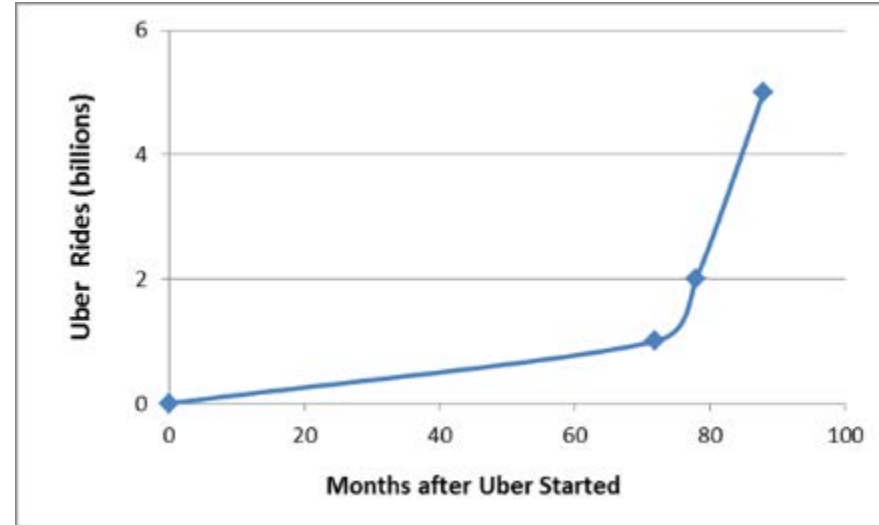
TNC: transportation network company

Photo credit: CleanTechnica

Shared Mobility: Recent Developments

Late 2000s:

- 1st smartphones: maps, mobility apps, geo-localization

- Zipcar & Flexcar, Avis-Hertz-Enterprise, City & eGo CarShare

- Public, municipal bike-sharing (Vélib')

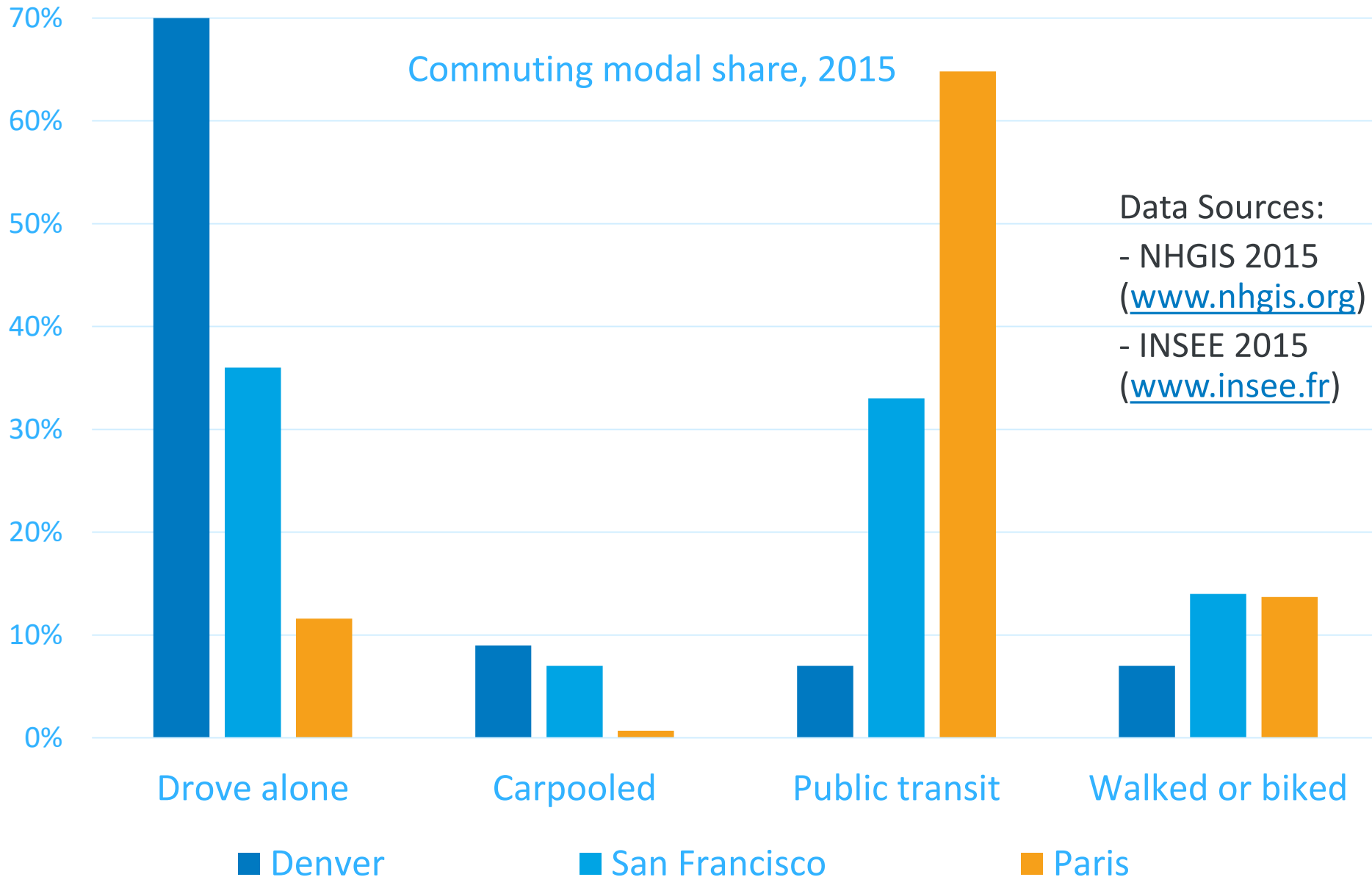- Inter-city carpooling (BlaBlaCar)

Early 2010s:

- 4G, NFC, BLE: ubiquitous connectivity

- EV car-sharing (Autolib'), P2P (Turo, Getaround)

- Denver B-cycle, Bay Area Bike-share

- UberX, Lyft, Sidecar
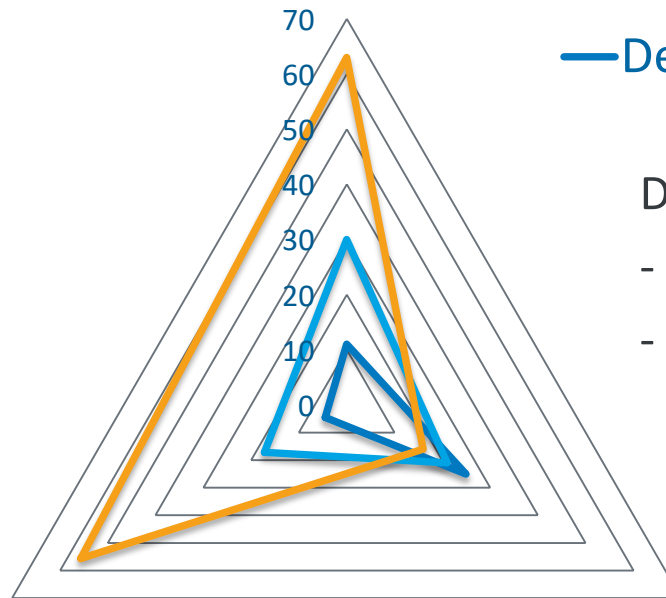
Late 2010s:

- Machine learning, computer vision: automation

- OEM run car-sharing (Car2go, Maven, ReachNow)

- Dockless bike-sharing, ebike-sharing

- UberPool, LyftLine, local and non-profit

- Commutes (Waze Carpool, BlaBlaLines)

Modal Share in Three Cities

Commuting modal share, 2015

Data Sources:
- NHGIS 2015 (www.nhgis.org)
- INSEE 2015 (www.insee.fr)

Legend: ■ Denver   ■ San Francisco   ■ Paris

Categories: Drove alone, Carpooled, Public transit, Walked or biked

Urban Form x Mobility Behavior

% Car-free Households (vertical axis, scale 0 to 70)

Legend: **Denver** — **San Francisco** — **Paris**

Population density (1000/sq. mi.) (axis)

Daily VMT (axis)

Data Sources:
- NHGIS 2015 (www.nhgis.org)
- INSEE 2014 (www.insee.fr)

VMT: vehicle miles traveled

	Denver	San Francisco	Paris, France
Car-free Households	11 %	30 %	63 %
Daily VMT	25 mi.	21 mi.	16 mi.
Population Density	4,520/sq. mi.	17,240/sq. mi.	55,670/sq. mi.

Congestion, Parking, Ownership, Public Health, Equity

- Empty or "dead-heading" TNC trips add to congestion, while other modes tend to reduce VMT and single-occupancy vehicle trips

- TNCs reduce the need for parking in dense areas

- Impacts on car ownership remain unclear – work in progress

- Shared services both substitute and complement active modes – depends on initial modal share

- Synergies with public transit (on-demand, first/last mile)

Energy Impacts: Back of the Envelope Calculations

% Change energy use resulting from 10% adoption of shared modes, electric vehicles, and autonomous vehicles

| Car-pooling | Car-sharing | Ride-hailing | Electric | Autonomous |
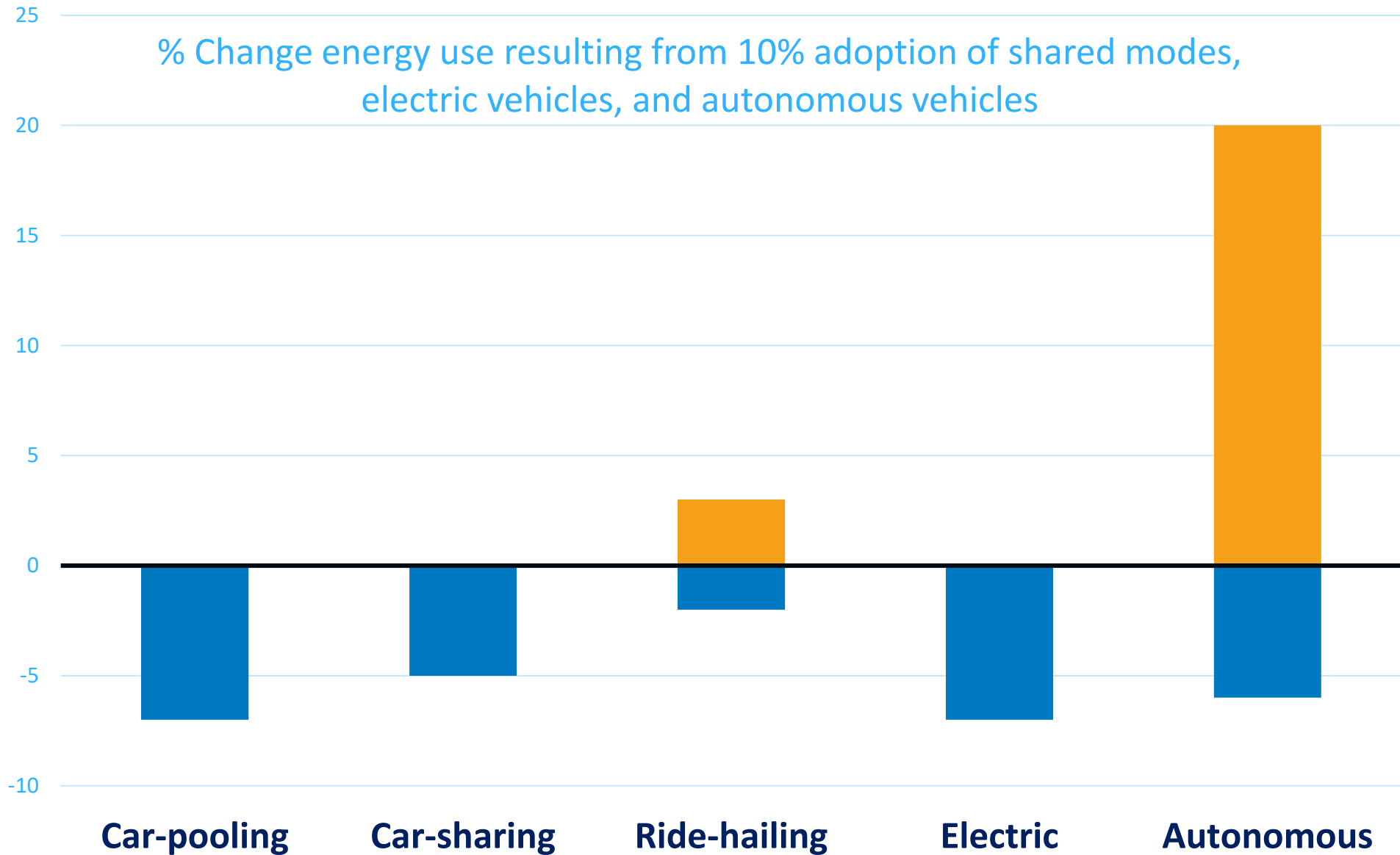
Overcoming Barriers: Scaling Shared Mobility

- Unified payment system: integrated mobility package with car- and bike-sharing, public transit, etc.

- Need for a user-friendly car-pooling platform enabling both shared commutes and long-distance trips available across the United States

- Incentivize ride-splitting for TNC drivers & passengers

- Urban planning: replace parking with pickup lanes & car-share-only spaces. Multi-modal hubs connecting transit with bike-sharing & first/last mile solutions

Key Takeaways

- Individual ownership → shared, access-based paradigm

- Potential for energy savings – and the opposite

- Shared services complement public transit & active modes

- Sharing & electrification should precede automation

- Need to move the needle on policy & urban development

Thank you!
Questions?

www.nrel.gov

- Car-pooling: derived using vehicle occupancy data from 2009 National Household Travel Survey

- Car-sharing: Chen and Kockelman, 2016, "Carsharing's Life-cycle Impacts on Energy Use and Greenhouse Gas Emissions"

- Ride-hailing: derived from Henao, 2017, "Impacts of Ridesourcing -Lyft and Uber- on Transportation including VMT, Model Replacement, Parking, and Travel Behavior"

- Electric vehicles: assumed 28 kWh/100 mi. (120 MPGe) BEV energy consumption and 36-mpg gasoline fuel consumption

- Autonomous vehicles: derived from Stephens et al., 2016, *Estimated Bounds and Important Factors for Fuel Use and Consumer Costs of Connected and Automated Vehicles*