

# The 3 Transportation Revolutions

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30 November 2016

**Vehicle Electrification**  
**+**  
**Shared Mobility**  
**+**  
**Automation**  
**=**  
**??**

# Revolutions?

*Societies and economies were transformed by British and American industrial revolutions, and then information revolution*

- **Electrification?**
  - Long lead time (since 1990) softens disruptions
  - Huge impact on auto industry, but impacts on society and economy are limited
- **Shared Mobility?**
  - Disruptive to taxis, likely automakers, and probably transit (in positive way)
  - If directed toward high load factors (Lyftline, Uberpool, micro-transit) then potential for broad transformations
- **Automation**
  - Potentially greatest impact of the 3
  - Could transform lifestyles, cities, economies

*Industrial revolutions comprise not just technical innovations but stream of economic, social, and political changes.*

# Challenge

- How to direct these “revolutions” toward the public interest?
  - Social equity
  - Sustainable cities (economics, lifestyles, livability)
  - GHG reduction

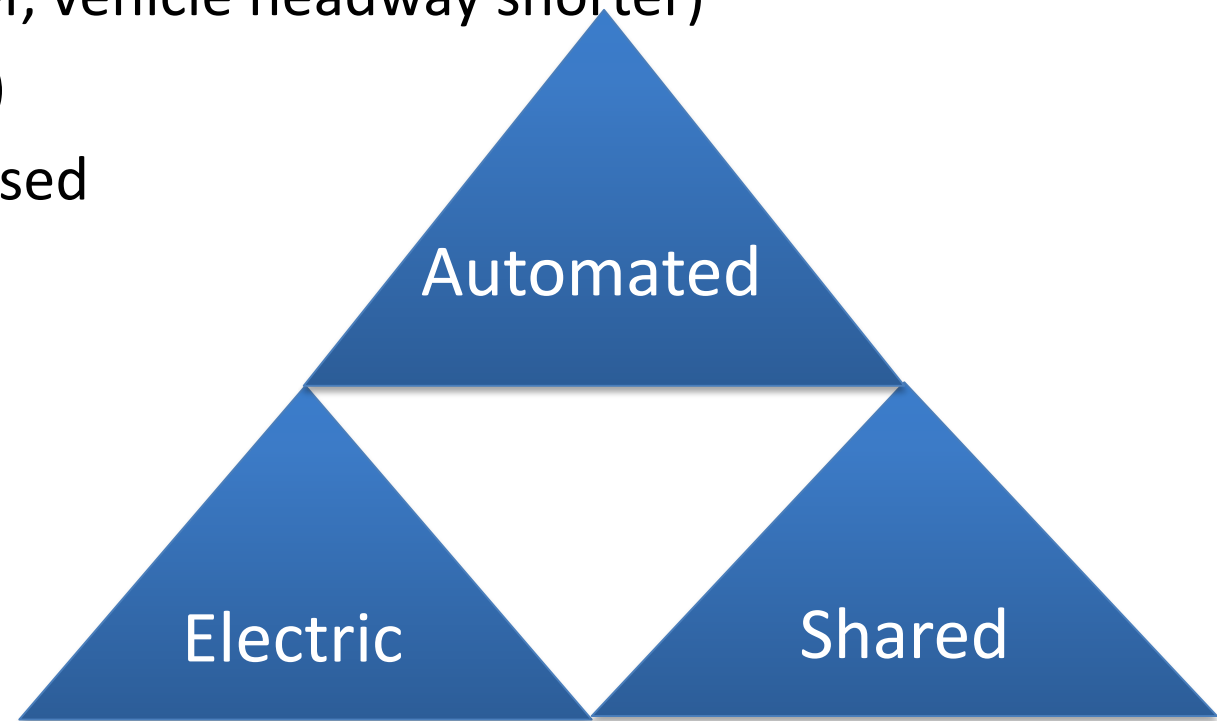
# Policy Briefs (Outputs of the Conference)

1. Maximizing the Social Equity Benefits of these Innovations
2. Clean Car Policies for Automation and Sharing
3. Synergies with Public Transit
4. Reducing Overall Vehicle Use with Automation and Shared Mobility
5. Road Pricing for Shared Use, ZEV, and Automated Vehicles
6. Active Transportation
7. Governance: Who's in Charge?

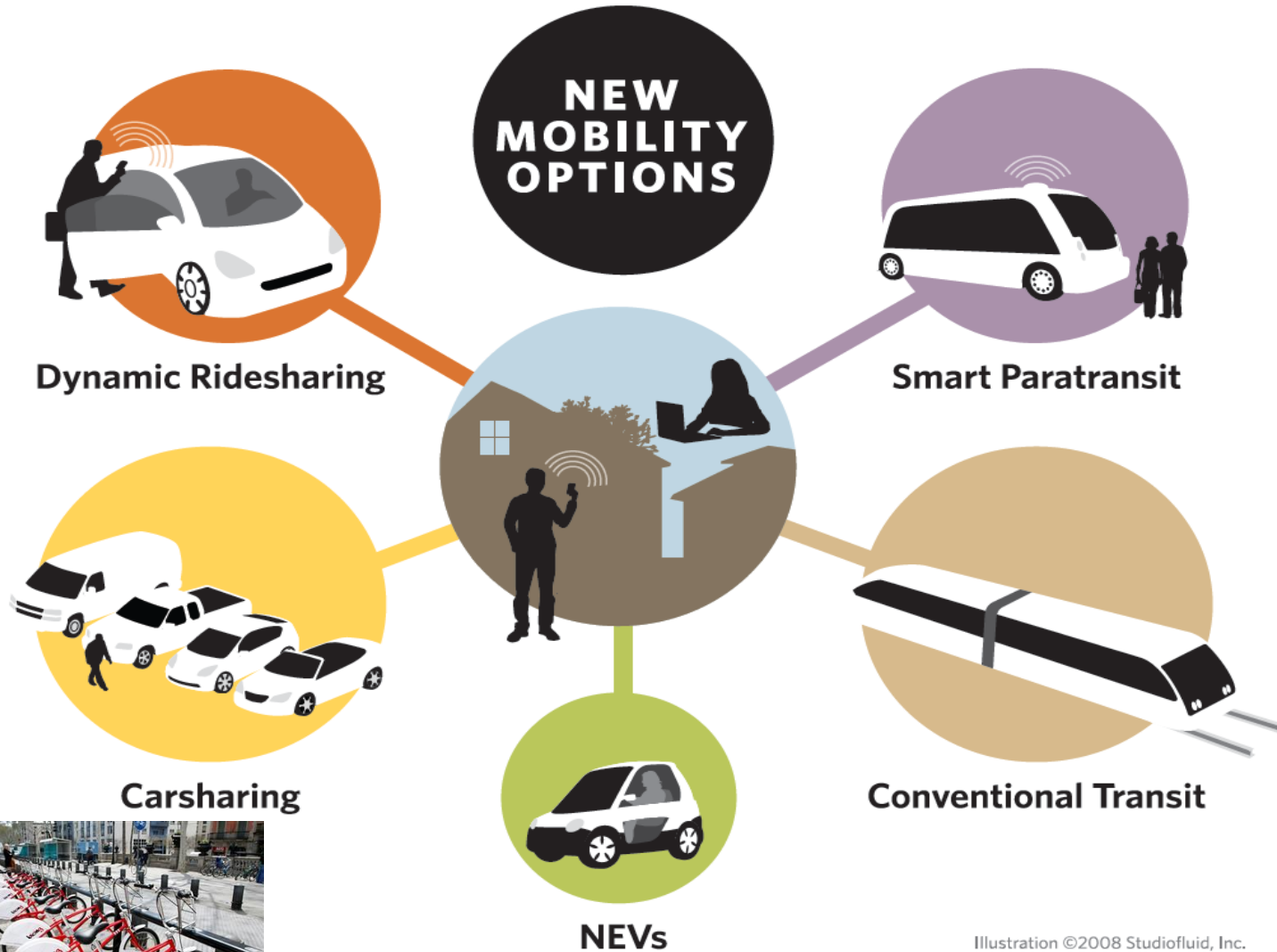
# Transportation Heaven ... when the 3 “revolutions” are integrated so that vehicles are shared, electric, and automated!

- Much safer (because automated)
- Less VMT (because of sharing)
- Much smaller/lighter vehicles (no need for steel frames, safety equipment)
- Much less traffic congestion (lanes narrower, vehicle headway shorter)
- More urban space (less parking, roadspace)
- EVs more economical because intensively used

➤ *Much less GHGs!*



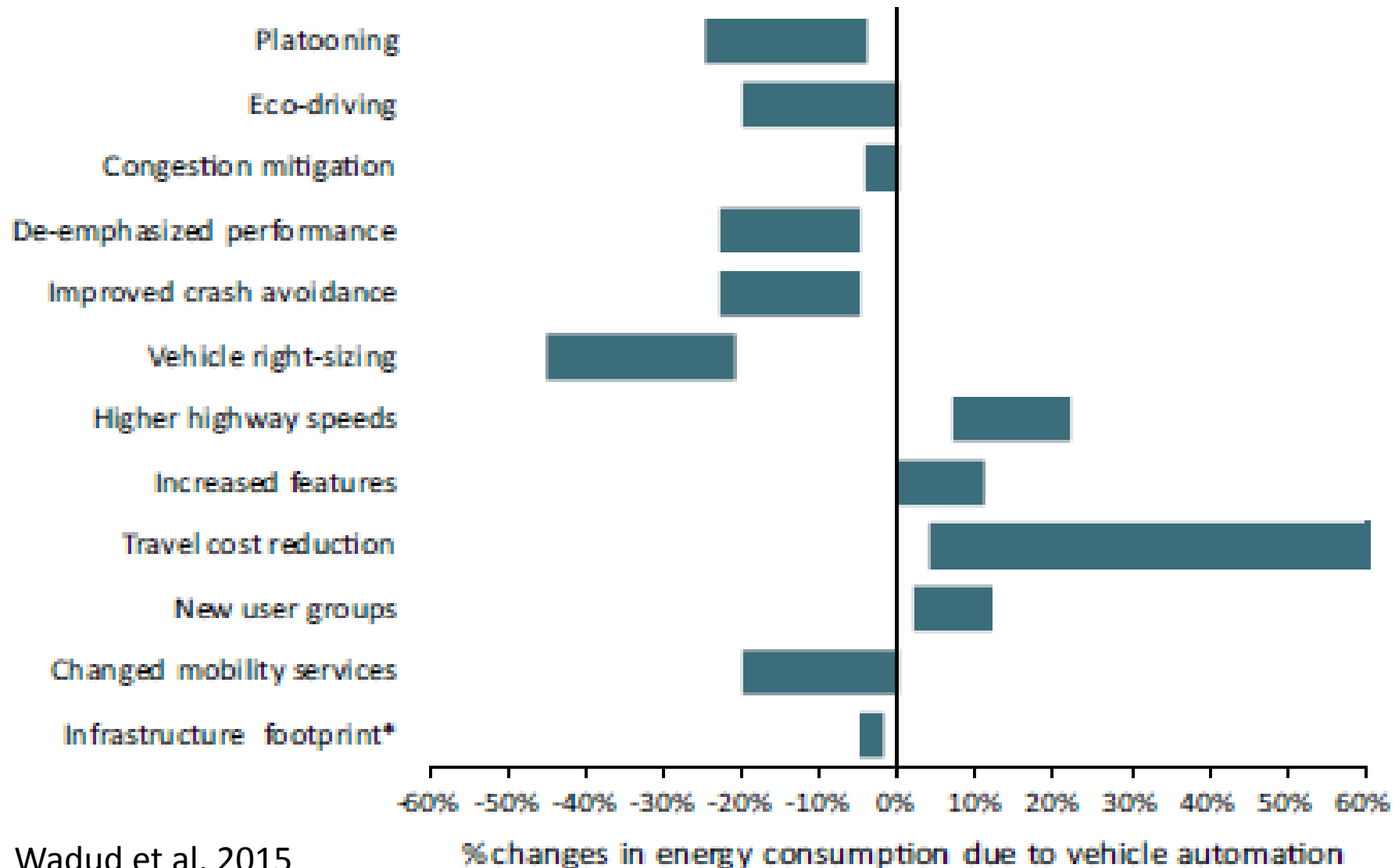
# Expand Traveler Choice Using ICT (Plus Automation)



- Increase vehicle occupancy
- Improve multi-modal connections
- Introduce new options to poorly served areas
- Reduce individual ownership

- *Converting fixed costs into variable costs (for travelers)*
- *Reduces VMT and Emissions*

# Vehicle Automation Increases or Reduces Energy Use/GHG's?!





## Some Evidence for Sustainability ... *but minimal so far*

- Carsharing participants own fewer vehicles than others (Martin et al. 2010)
- Those who use ride-sourcing services may have lower VMT (Rayle et al. 2014), and
- ... in some cases reduced levels of vehicle ownership (Dutzik et. al 2013)
- Those who use on-demand ridesharing services also tend to use transit (American Public Transportation Association 2016)

# Key Questions

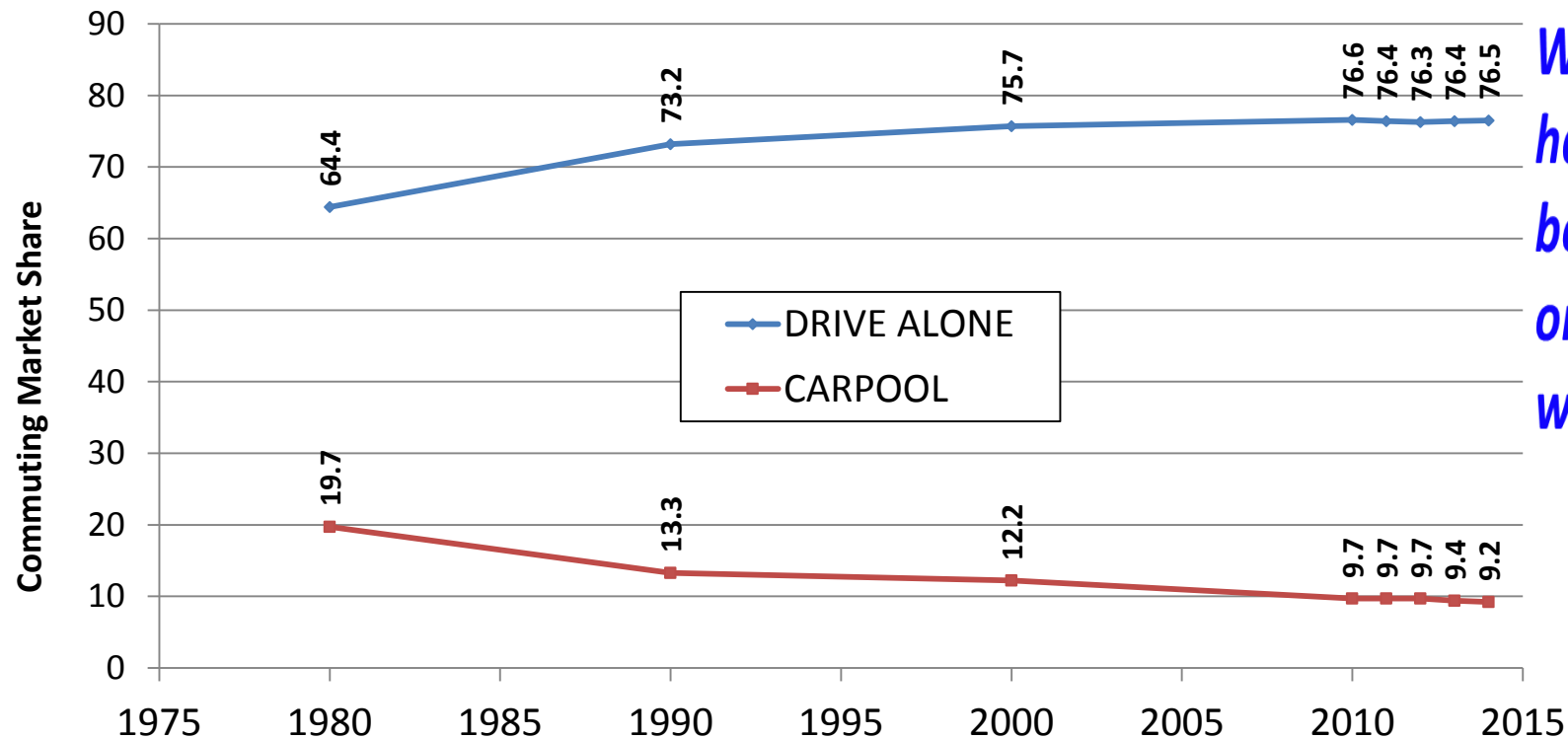
1. How many people at what price are willing to share rides?
  - More or less willing with AVs?
2. Under what conditions will people give up their cars?
  - More or less willing with AVs?

Key “risk”: AVs would be mostly personally owned

- Much more VMT (including “zombie” cars)
- Greater split between rich and poor

# Do Travelers Want to Share a Ride?

**Carpooling has largely failed!**



*Will a generation, many of whom haven't shared bathrooms or bedrooms or phones or televisions or dorm rooms, share small vehicles with strangers?*

# Is Low Price Enough to Induce “Pooling”?

## Cost of Car vs Transit vs Uber/Lyft (adapted from Polzin, 2016)

Source: IRS

Auto Capital and Operating Cost (business) \$0.57/mile

“Out of Pocket” (defined by IRS for charity) \$0.14

BLS Consumer Expenditure Survey \$0.44/ vmt

\$0.26/ pmt

Transit Fares ~ \$0.24/mi

TNC “Glorified Taxis” (Uber/Lyft) ~\$0.65-2.00/mi

TNC Pooling (UberPool, LyftLine) ~\$0.35-1.00/mi

Automated Vehicle (shared ride) ~<\$0.20-???? (plus benefits of “free time”)

# Ownership Not Just a Mobility Decision (slide by Steve Polzin)



Functional  
transportation



Ego



Investment

Image

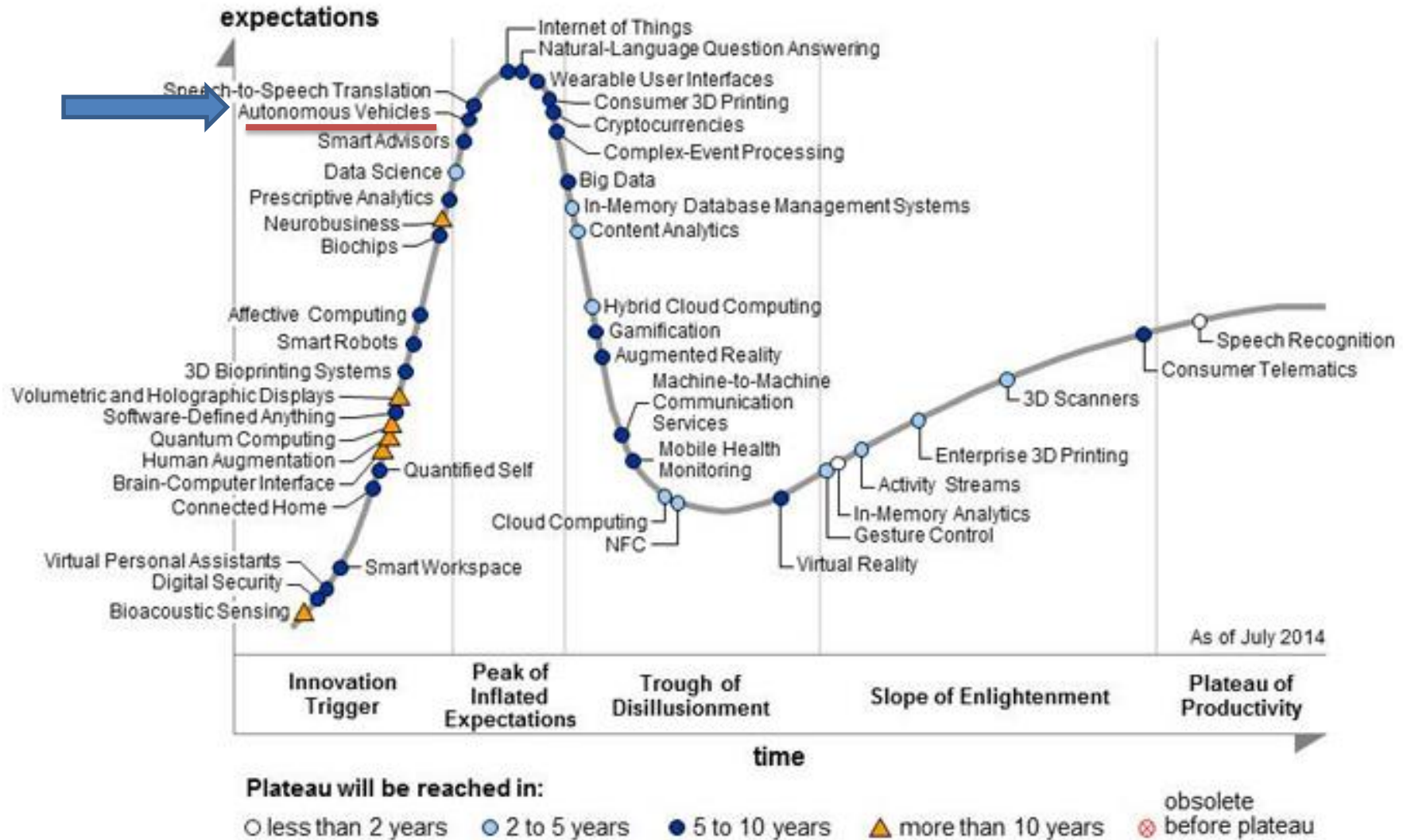


Hobby

Entertainment

Transportation  
plus?

# Hype Cycle for Emerging Technologies



Source: Gartner (August 2014)

# AV Sales Promised by 2019-2021

& New Companies Emerging

## Old guard:

- GM
- Ford
- Toyota
- Nissan
- Volvo
- BMW
- Audi
- Volkswagen

## New companies:

- Google
- Tesla
- Uber
- Apple
- Many startups

## Driverless Car Market Predictions

Prediction	Year in the Market (Year Announced)
Google's founder Sergey Brin	2018 (2012)
Volkswagen head of Digitalization Strategy, Johan Jungwirth (not necessarily Volkswagen brand)	2019 (2016)
General Motors head of foresight, Richard Holman	2020 (2016)
Ford's head of production development, Raj Nair	2020 (2016)
Toyota	2020 (2015)
Andy Palmer, the Executive Vice President of California-based Nissan Motors Ltd	2020 (2013)
Ford CEO, Mark Fields	2021 (2016)
BMW CEO, Harald Krueger	2021 (2016)
Baidu's Chief Scientist	2021 (2016)
Tesla's Founder, Elon Musk	2021 (2015)
Justin Rattner, CTO of Intel	2022 (2012)
Jaguar and Land Rover's Director of Research and Technology	2024 (2014)
U.S. Department of Transportation	2025 (2015)
Dieter Zetsche, Chairman of Daimler	2025 (2014)
Automotive Supplier Continental	2025 (2012)
Robert Hartwig, President of the Insurance Information Institute	2028 (2013)
Institute of Electrical and Electronics Engineers (IEEE)	2040 (2012)

# Will There be a Backlash?

## Modification to the Second Amendment to the U.S. Constitution

A well regulated militia being necessary to the security of a free State, the right of the People to keep and bear arms <sup>and drive cars</sup> shall not be infringed.

Adopted December 15, 1791

Amended June 20, 2021



# What is Likely?

- Minimal public benefits until cars are fully driverless
  - Traffic congestion, VMT, GHGs, safety
- Fully automated cars are inevitable
- Fully driverless cars will be introduced in early 2020s, but very few and only in very limited circumstances
  - e.g., Lyft/Uber cars on select routes
  - How many individuals would buy expensive automated cars?
  - Policy challenges (safety regulations, opposition by many?)

**With a little advertisement on California test track...**

# Connected Vehicle and Autonomous Vehicle (CV/AV) Program and Test Facility

Randy Iwasaki  
Executive Director  
Contra Costa Transportation Authority  
December 1, 2016










Over 20 miles of paved roadways including a 7-mile long spine road for high speed testing



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*Thank You*