

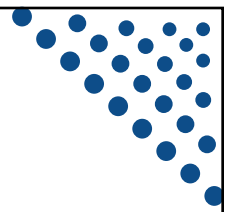
Osher Lifelong Learning Institute, Winter 2023 **Contemporary Economic Policy**

Sonoma State University
February-March, 2023

Host: Jon Haveman, Ph.D.
National Economic Education Delegation



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Available **NEED** Topics Include:

- The U.S. Economy
- Healthcare Economics
- Economic Inequality
- Economic Mobility
- US Social Policy
- Trade and Globalization
- Minimum Wage
- Climate Change
- Immigration Economics
- Housing Policy
- Federal Budgets
- Federal Debt
- Black-White Wealth Gap
- Autonomous Vehicles



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Course Outline

• Contemporary Economic Policy

- Week 1 (2/1): **Trade and Globalization (Alan Deardorff, Univ. of Michigan)**
- Week 2 (2/8): US Economic Update (Jon Haveman, NEED)
- Week 3 (2/15): Trade Deficits and Exchange Rates (Alan Deardorff)
- Week 4 (2/22): Economic Mobility (Jon Haveman)
- ~~Week 5 (3/1): Cryptocurrencies (Jon Haveman)~~
- Week 5 (3/8): Autonomous Vehicles (Jon Haveman)
- Week 6 (3/15): Cryptocurrencies (Jon Haveman)



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Submitting Questions

- **Please submit questions of clarification in the chat.**
 - I will try to handle them as they come up.
- **We will do a verbal Q&A once the material has been presented.**
 - I will also do some Q&A during the break.
- **Slides will be available from the NEED website tomorrow (https://needelegation.org/delivered_presentations.php)**



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OLLI – Sonoma State University

Driving Change – Autonomous Vehicles' Big Impact

National Economic Education Delegation

Jon Haveman, Ph.D.

March 8, 2023



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Credits and Disclaimer

- **This slide deck was authored by:**
 - Jon Haveman, NEED
- **This slide deck was reviewed by:**
 - Ronald Fisher, Michigan State University
 - William F. Fox, University of Tennessee, Knoxville
- **Disclaimer**
 - NEED presentations are designed to be nonpartisan.
 - It is, however, inevitable that the presenter will be asked for and will provide their own views.
 - Such views are those of the presenter and not necessarily those of the National Economic Education Delegation (NEED).



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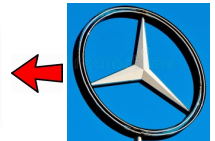
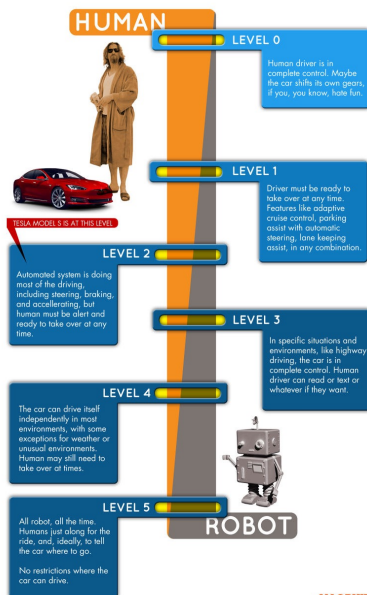
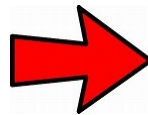
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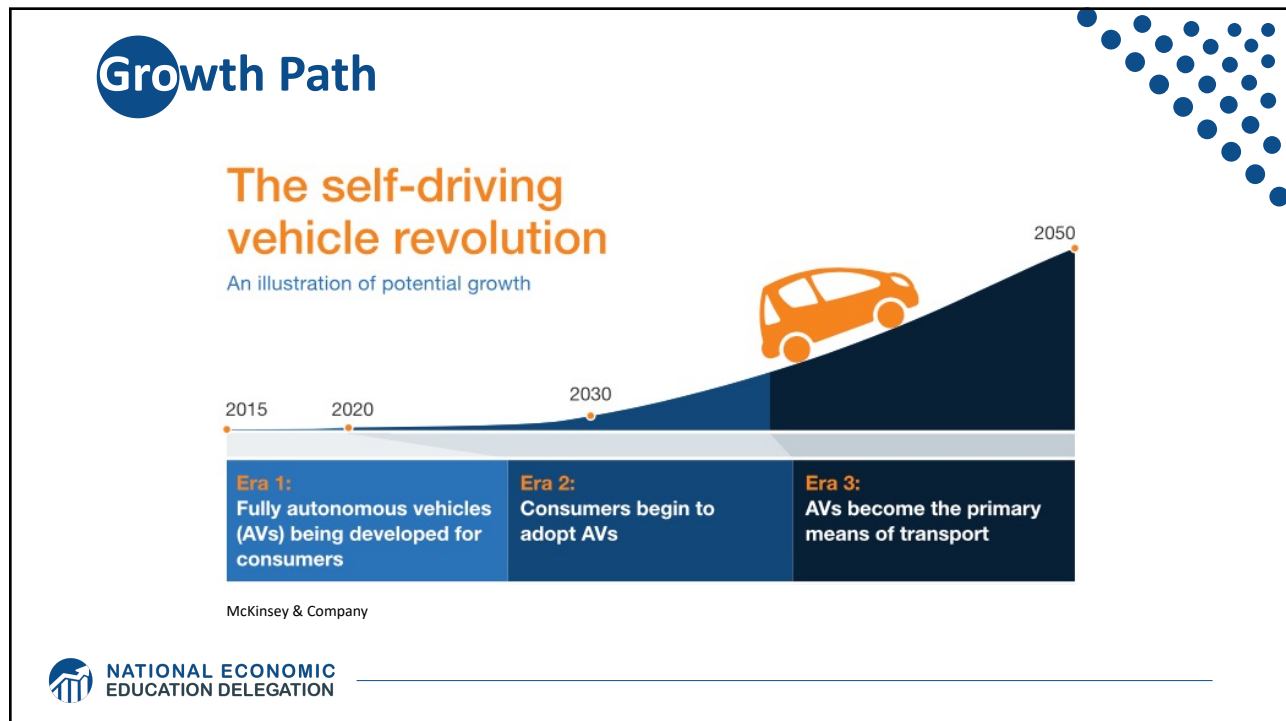
Outline

- Where does the AV path lead?
- Policy/Planning Issues
- Major Economic/Development Changes

Autonomous Taxonomy

SAE AUTONOMY LEVELS





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McKinsey isn't Always Spot On

- "In 1980, McKinsey & Company was commissioned by AT&T to forecast cell phone penetration in the U.S. by 2000.
 - The consultant's prediction, 900,000 subscribers,
 - was less than 1% of the actual figure, 109 Million."
 - Professor Angel Lozano, 2014

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Three Important Questions:

1. When will Transportation as a Service (TaaS) be available?
2. How quick will the transition be?
3. What will the future look like?



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WHEN? What do the headlines say?



NVIDIA to introduce level-4 enabling system by 2018



First autonomous Toyota to be available in 2020



Volkswagen

Volkswagen expects first self driving cars on the market by 2019



Audi

Audi to introduce a self-driving car by 2020



TESLA MOTORS

Elon Musk now expects first fully autonomous Tesla by 2019, approved by 2021



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40+ Corporations Working On Autonomous Vehicles



TOYOTA



WAYMO



HONDA



Audi



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WHEN?

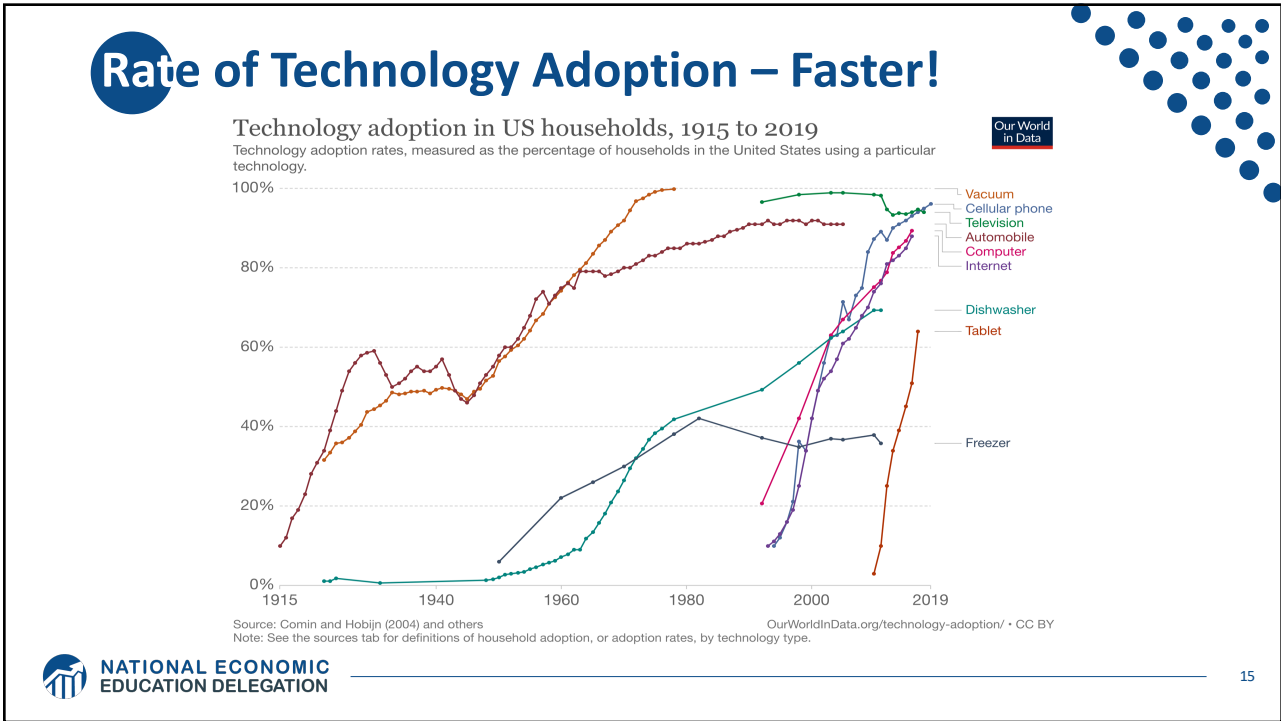
What is possible?

- **By 2025 (?)**
- **Potentially 95% of VMT by 2035.**
 - Last 5% may be very difficult to achieve.
- **Is this possible?**
 - Horses to cars: 10 years – early 1900s
 - But adoption of EVs is so slow!
 - Adoption of AVs will be rapid.

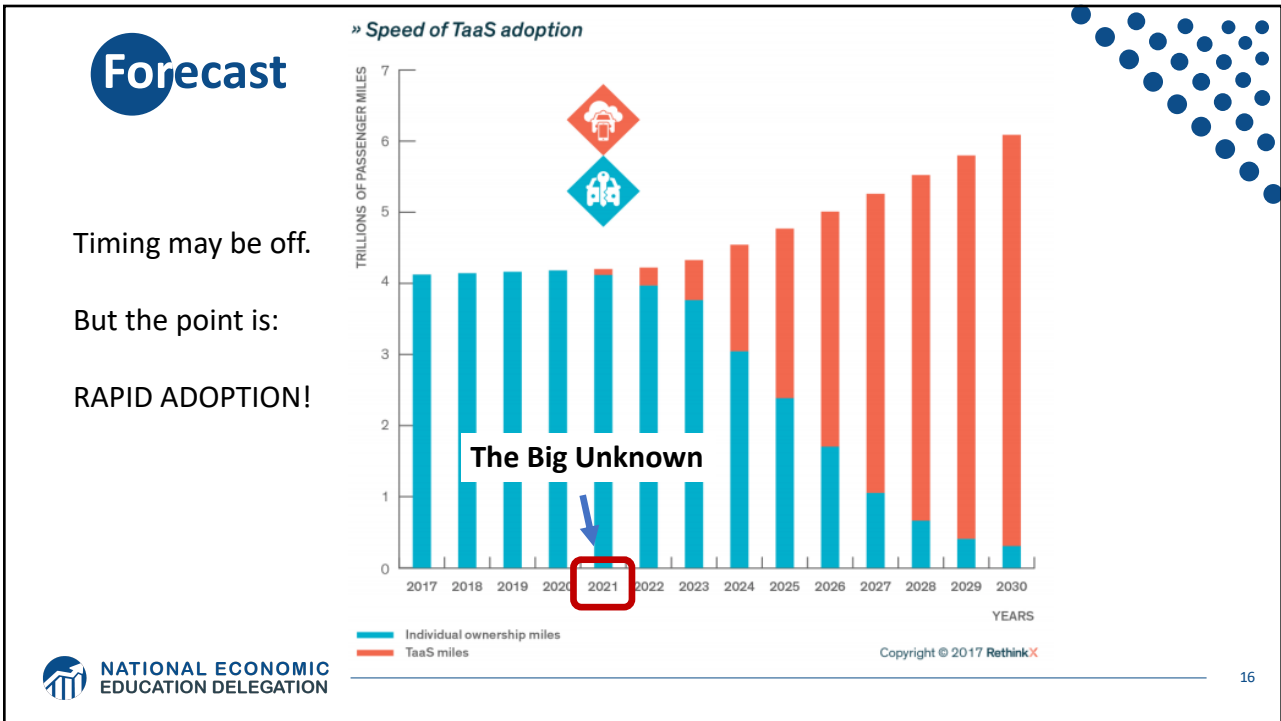


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Waymo's self-driving cars are now available on Lyft's app in Phoenix

Lyft and Motional's all-electric robotaxi service is now live in Las Vegas

Singapore's self-driving cars can now be hailed with a smartphone


NuTonomy joins forces with 'the Uber of Southeast Asia'

Cruise is now charging for rides in its driverless vehicles in San Francisco

Fee-For-Service Autonomous TaaS

- **Cruise: San Francisco driverless on June 1, 2022**
- **Motional: Las Vegas in early 2023**
- **More are surely coming soon....**

Waymo is Headed to New York!



Waymo driving territory

New York City

Image courtesy of Waymo

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Trucking – Highly Fertile Ground

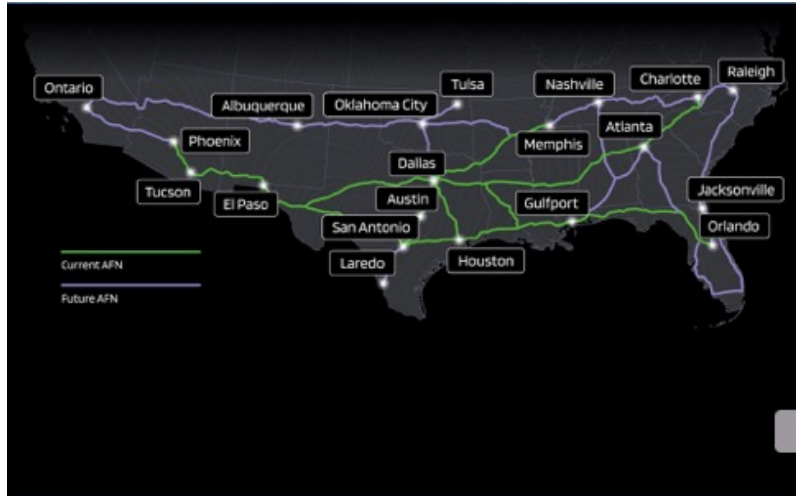
- **Long haul trucking is likely the first place we will see it adopted.**
 - Reduces costs associated with drivers.
 - End run around limits on hours of driving.
- **Where does it stand?**
 - Lots of trials underway.
 - TuSimple – actively building a long haul network.
 - Waymo – focused more on last mile/local delivery.

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TuSimple Current and Future Routes (Level 4)



44 states
allow autonomous semi-truck testing

26 states
allow autonomous semi-truck commercial deployment

50 states
cohesive AV operations framework laid out in US DOT 4.0 AV Regulations

Actively Pursuing Autonomous Local Delivery

- Dominos
- Walmart
- Amazon
- CVS Pharmacy
- Stop and Shop
- Postmates
- Kroger



What will the future look like?



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This:



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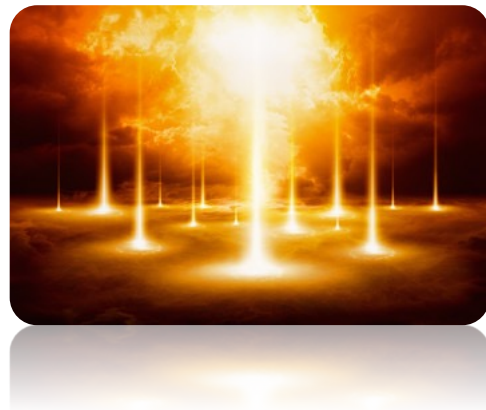
But, will it be:



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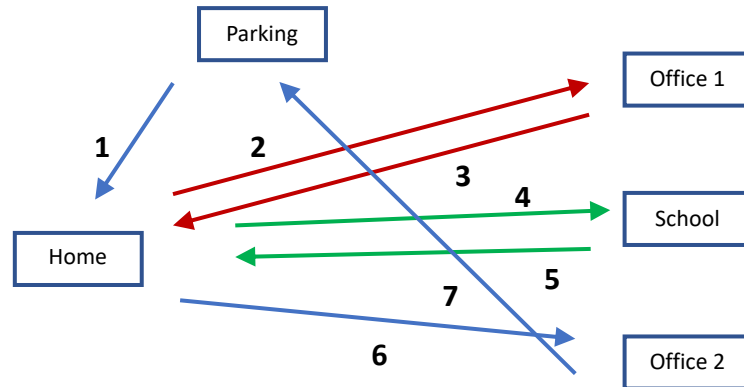
Hell

- **Primarily individual private car ownership**
 - Much as today.
- **Internal combustion engines**
- **Why Hell?**
 - Dramatically increased VMT and pollution.
 - Potentially increased congestion.
 - Parking



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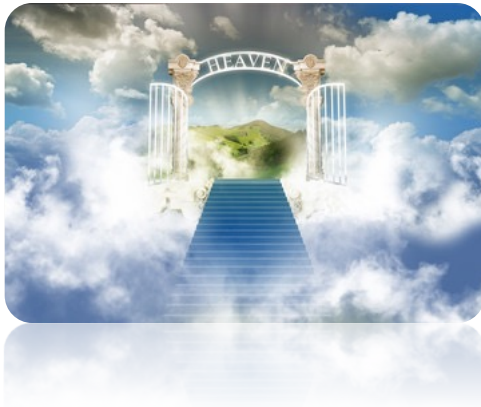
Two Adults and a Child: Morning Miles



And this is just the morning.....

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Heaven



- **Vehicle ownership will be very limited**
 - Private ownership for those with specialized vehicle needs.
 - Fleet ownership will serve everybody else.
- **Engines: electric**
- **Insurance: product liability**
- **Not clear when we will get there, but this is the likely model.**
 - 2030 for widespread adoption in many regions.

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Why is this Heaven?

- **Not only autonomous, but:**
 - Shared
 - Connected
 - Green
- **Far fewer cars in existence.**
 - Better resource utilization: steel, rubber, aluminum, and land!
- **VMT could go up or down, but more productive than in Hell.**
- **Congestion effects – unclear, but likely reduced.**
 - Right-sized vehicles, platooning, sharing, V2V communication
- **Minimal need for parking.**



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Transition

- **Short term: Tesla model of highway autonomy**
 - Level 2, adaptive cruise control
- **Medium term:**
 - short period of personal vehicle ownership with level 3 capability
 - introduction of independent private fleets – Uber, Lyft, Google, nuTonomy, etc., with level 4/5 capability
- **Long term:**
 - Personal vehicle ownership is largely a thing of the past



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Economics Drives Transition: Private

- **Adoption dividend for private individuals**

- Eliminate car ownership
 - Ave annual cost of owning a car: \$10,728 (2022)
 - Cost per mile will fall: \$0.72 to \$0.19
- Repurpose your garage
 - \$50,000 from transition to bedroom

Average Ownership Costs Per Mile

Miles per Year	10k	15k	20k
Average Cost	76¢	72¢	70¢

- **Time recovery**

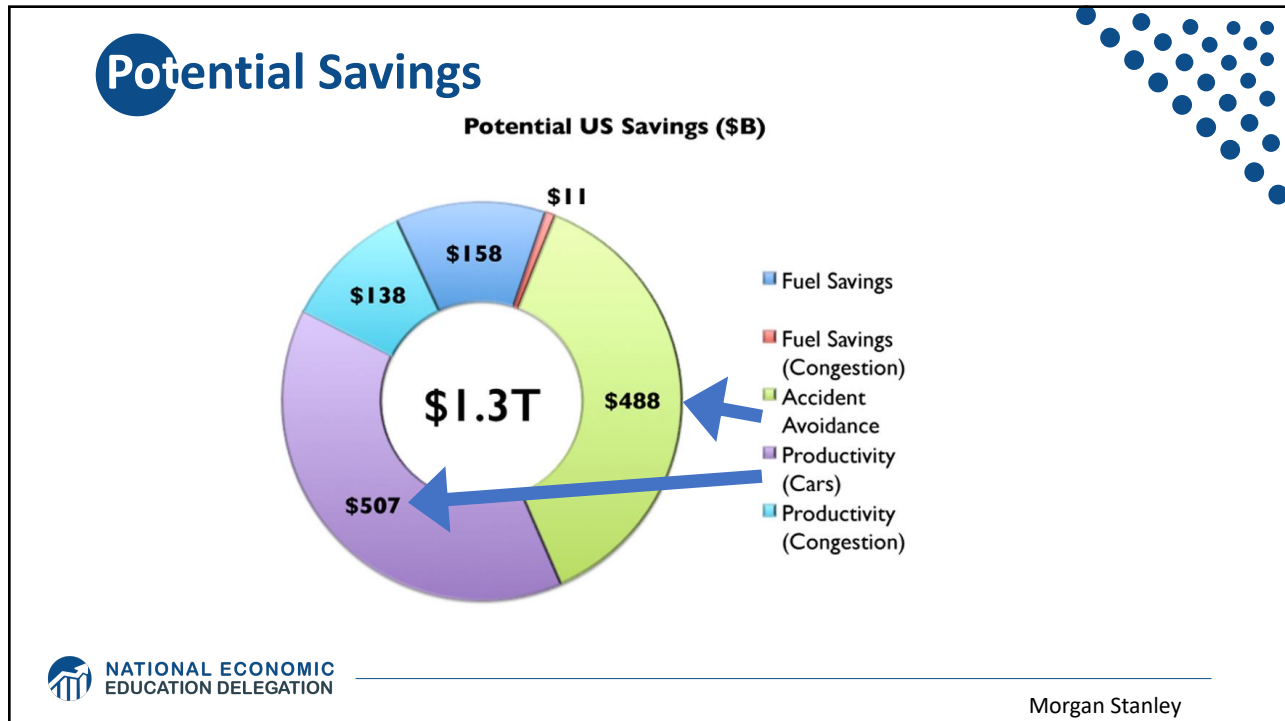
- 50% of the SF Bay Area workforce has a commute in excess of 30 minutes.

Economics Drives Transition: Public

- **Economic and social costs associated with human drivers are enormous:**

- ACCIDENTS:
 - Drive 25% of congestion.
 - Result in 40,000 deaths.
 - And 2 million injuries.
 - 90+% caused by human error.
- Increased productivity from not driving.
- Costs of human drivers estimated at up to \$1.3 TRillion each year





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Public Policy/Planning Issues

- Government buy-in:**
 - Essential – gov’t must encourage progress
 - Difficult – because of displacement issue
- Important transitional issues:**
 - What infrastructure should be developed?
 - What to do about public transportation?
 - What to do with all of the parking spaces?

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Planning

- **Respond to the coming changes**

- The planning horizon for any investment in transportation infrastructure based on today's predominant technology has changed.
 - It may have gotten **MUCH shorter**.

- **Encourage the changes to happen more quickly**

- Mobility, safety, productivity, and environmental benefits abound.



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Responding to the coming changes:



- **Transportation organizations must develop a forecast for adoption in their specific geography**

- San Francisco – faster than Chicago
- Chicago – faster than Fresno
- Fresno - faster than Kansas

- **How does this affect the ROR calculation on projects?**

- Highway expansion? Public Transportation?



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Encourage Change

- **Mobility and equity considerations**
 - Elderly/disabled/impoverished
- **Safety:** only way to reduce traffic fatalities is by coordinated effort
- **Productivity:** reduced congestion
- **Environment:** speed transition to electric vehicles

These are all societal benefits that come about too slowly if the private market is left to itself.

Mobility and Equity

- **Mobility**
 - Handicapped
 - Elderly
 - Lower income
- **Equity**
 - Public Transportation often does not work well for low-income workers/residential workers
 - Does not go from residential to residential, but from residential to commercial



Safety and Productivity



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Environment



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Environmental Implications Depends: Heaven or Hell

- **Improved resource utilization**
- **More efficient travel**
 - Right sized vehicles
 - Optimized routes
 - Reduced congestion
 - No searching for parking
- **Increased VMT**
- **Cleaner technologies**
 - Electric
 - Lighter vehicles
- **Energy use of onboard electronics**
 - Weight and functional
- **Increased urban sprawl**

Bottom line: push governments at all levels to embrace and to implement policies deterring private vehicle ownership and zero passenger miles



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Incentives Through Policy and Planning

- **Allow vehicles equipped with ACC into HOV lanes**
 - Eventual conversion of HOV lanes to ACC/AV lanes
- **Allow ACC equipped vehicles to travel faster in HOV lanes**
- **Subsidize ACC upgrades**
 - Arguably more concrete benefits than electric vehicles
- **Sticks: higher costs of vehicle ownership**
 - Registration fees, VMT taxes, etc.



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Note: ACC = Adaptive Cruise Control

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Interim Summary

- **Transition is coming very quickly!**
 - Most reports are extremely conservative
 - Apply generally, but faster in many regions.

- **Very important to start incorporating AVs into planning now.**
 - To realize the benefits of AVS.
 - Sacrifice expansion for maintenance.



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What Changes Will This Bring?

- | | |
|--------------------------------|--------------------------------|
| • Disposable income | • Housing |
| • Government finances | • Public transportation |
| • Transportation demand | • Employment |
| • Infrastructure | • Parking |

Potentially dramatic improvements in infrastructure planning and maintenance -
Data sharing and integration



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Disposable Income



- Costs \$10,728 to own a car
- Will cost \$3,000 to use TaaS
- Net increase in disposable income of > \$7,000
- Spread across all households: more than \$1 trillion in new spending in the economy
- Major boost to economic activity
 - CREATING JOBS!

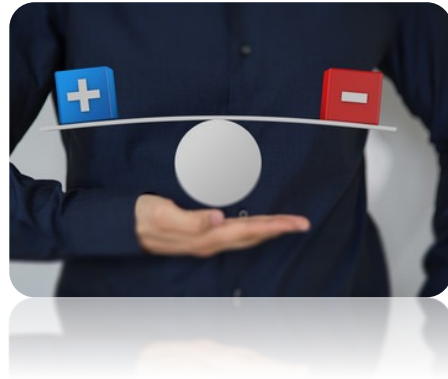
Government Finances



- **Government finances thrown for a loop:**
 - Revenues up and down:
 - Parking revenue, tickets, traffic violation revenues
 - More commercial, retail and residential space
 - Less spending on road development
 - More (maybe less) spent on road maintenance
 - Fewer road miles
 - but perhaps more VMT

Transportation Demand

- **Demand for transportation will likely increase significantly: price falls, demand rises**
 - Commutes may increase in distance, but not necessarily in duration
 - Zero passenger trips will arise
 - Deliveries
- **At the same time, demand for roadway lane-miles will likely decrease**
 - AVs make significantly more efficient use of space
 - Front to back and side to side



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Infrastructure

- **Focus of transportation infrastructure:**
 - Currently on expansion
 - Will turn toward:
 - Maintenance
 - Signage and striping has to be robust
 - TaaS providers push for fewer potholes?
 - Adding technology
 - Stop lights will be digital as well as visual
 - Some will disappear: Signs!



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Housing



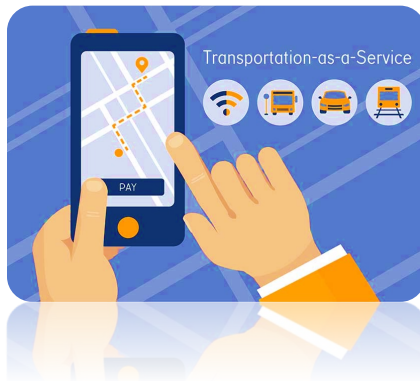
- **Housing is suddenly easier to build**
 - Issue of traffic congestion is significantly reduced.
 - Space for new housing is available where parking lots used to be.
- **Existing houses can now accommodate more people: garage to bedroom conversions.**



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Public Transportation



- **Ambiguous implications for public transportation**
- **Demand may:**
 - Shrink because of low cost of TaaS
 - Grow because last mile problem is solved
- **Extensions may be added through contract with TaaS company**



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Cautionary Tale From Long Ago

- **Automobiles impact on rail:**

“The increasing dominance of cars was also felt by railway companies, which by June 1894 had to start making **pricing concessions** for transporting goods, even including free transport.”



- Samuel I. Schwartz, No One at the Wheel, 2018

Employment

- **Massive job displacement/relocation (Millions!):**

- Drivers of all varieties: truck, taxi, delivery...
- Car production jobs, car parts production jobs
- Gas station, vehicle repair, and body shop
- Police and fire
- Health care workers
- And so on...



Employment (con't)



- **What jobs will be created?**
 - IT jobs
 - Retail/Production jobs
 - ??
- **Always easier to identify things that will go away than to identify what will pop up in its place.**
- **Regardless of where they are created, training programs will be crucial to the transition.**



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Parking

- **Greatly reduced demand for parking lots.**
- **Service providers will own parking lots in strategic places.**
 - Where the cost of land is low.
- **Street parking will largely be a thing of the past.**
 - More green space in cities.
- **Shopping mall parking will be converted to:**
 - More shopping mall? Housing?
- **Apartment complexes will convert parking.**



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Freeing Up Urban Space from Parking

- **Los Angeles: 14% of incorporated land area**
 - 200 Square miles
- **San Francisco: 275,450 on-street parking spaces**
 - Enough to parallel-park a line of cars 900 miles.
 - California's entire coastline is 840-miles.
 - Enough parking to cover the **Presidio, Golden Gate Park, and Lake Merced.**
- **Nationwide: (estimate) 500 million spaces**
 - That's larger than Delaware and Rhode Island combined.
 - Could be as many as 2 billion (add in Connecticut and Vermont).



Potential Problems and Concerns

- **Expansion of the electric grid to provide sufficient capacity.**
- **Mining for rare earth minerals for batteries.**
- **Hacking of autonomous vehicles for nefarious purposes.**
- **Competition in service provision in some markets.**
- **And many more...**



Summary of Change

- Massive employment upheaval.
- Local government finances will look very different.
- Housing will be easier to build and more plentiful.
- Parking conversions will be commonplace.
- Demand for transportation infrastructure will likely decline.
 - Transportation infrastructure technology will be a booming business.
- Demand for public transportation may well decline.
- Coming likely sooner rather than later!



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Thank you!

Any Questions?

www.NEEDelegation.org

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