

Osher Lifelong Learning Institute, Winter 2022

Contemporary Economic Policy

University of Arizona
January-March, 2022

Jon Haveman, Ph.D.
National Economic Education Delegation



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1

1

Course Outline

• Contemporary Economic Policy

- Week 1 (1/27): US Economy & Coronavirus Economics
- Week 2 (2/3): Climate Change (Simone Wegge, CUNY, Staten Island)
- Week 3 (2/10): Immigration (Roger White, Whittier College)
- Week 4 (2/17): Trade (Alan Deardorff, University of Michigan)
- Week 5 (2/24): The Black-White Wealth Gap (Me)
- **Week 6 (3/3): Autonomous Vehicles (Me)**



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2

2

Driving Change – Autonomous Vehicles’ Big Impact

National Economic Education Delegation

Jon Haveman, Ph.D.

March 3, 2022



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3

National Economic Education Delegation

- **Vision**

- One day, the public discussion of policy issues will be grounded in an accurate perception of the underlying economic principles and data.

- **Mission**

- NEED unites the skills and knowledge of a vast network of professional economists to promote understanding of the economics of policy issues in the United States.

- **NEED Presentations**

- Are **nonpartisan** and intended to reflect the consensus of the economics profession.



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4

4

Who Are We?

- **Honorary Board: 54 members**

- 2 Fed Chairs: Janet Yellen, Ben Bernanke
- 6 Chairs Council of Economic Advisers
 - Furman (D), Rosen (R), Bernanke (R), Yellen (D), Tyson (D), Goolsbee (D)
- 3 Nobel Prize Winners
 - Akerlof, Smith, Maskin

- **Delegates: 651+ members**

- At all levels of academia and some in government service
- All have a Ph.D. in economics
- Crowdsource slide decks
- Give presentations

- **Global Partners: 48 Ph.D. Economists**

- Aid in slide deck development

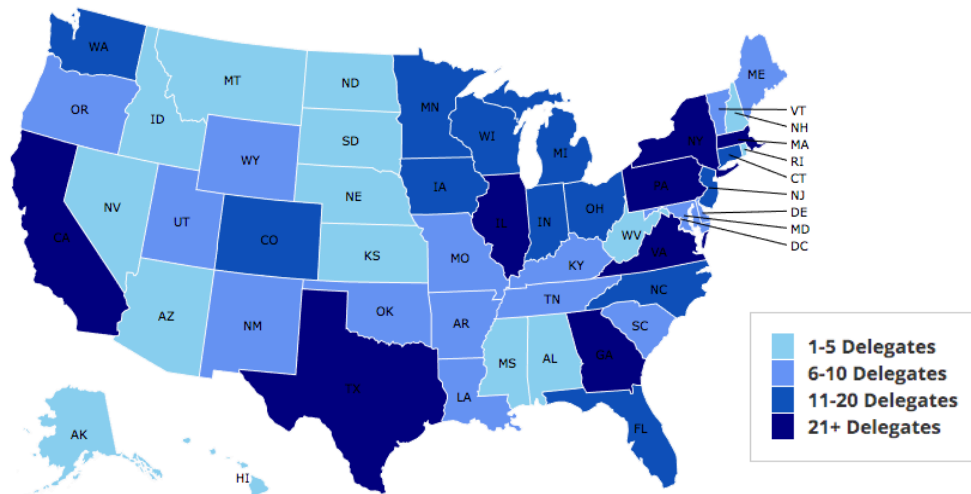


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5

5

Where Are We?



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6

6

Available NEED Topics Include:

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



7

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).



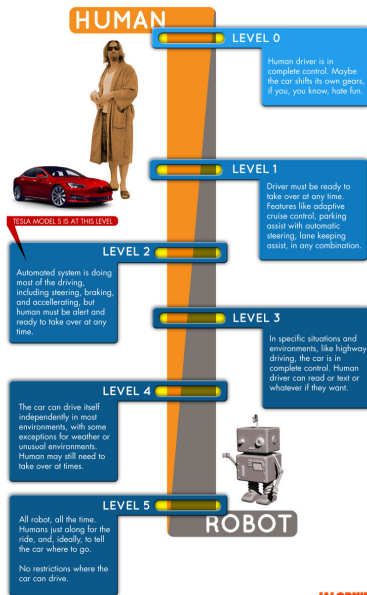
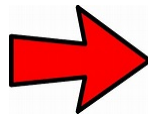
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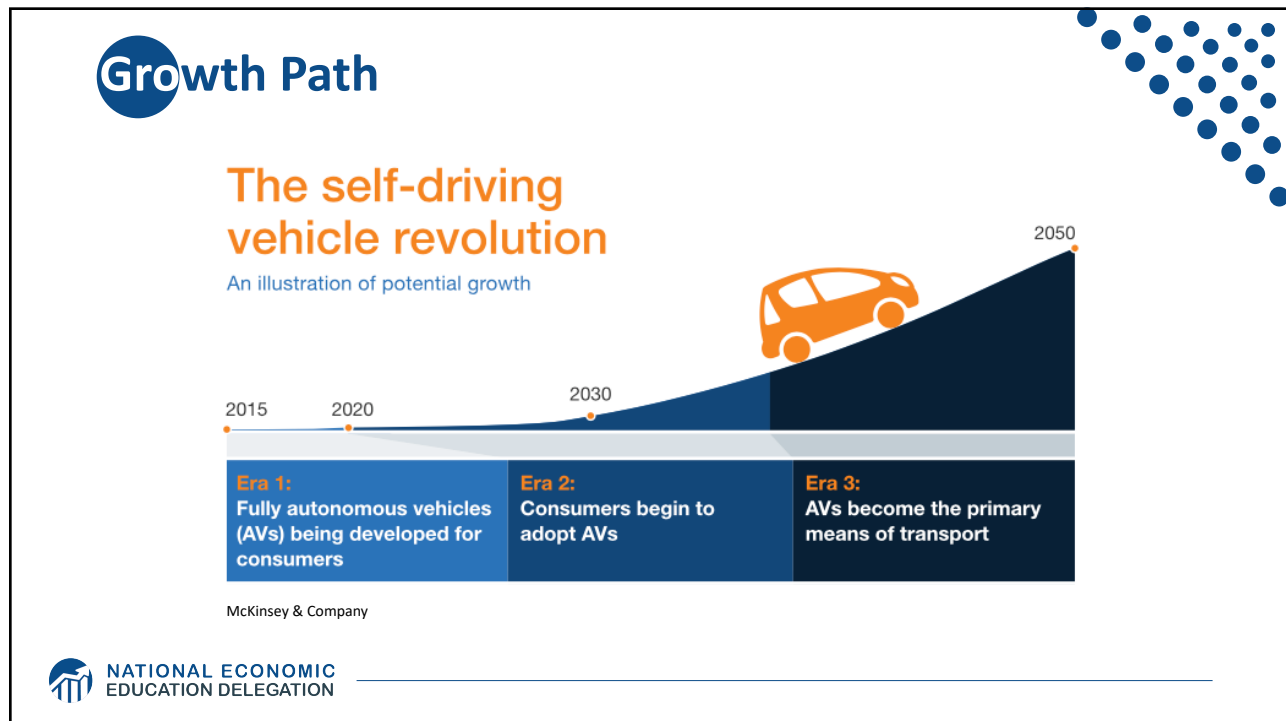
Outline

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

Autonomous Taxonomy

SAE AUTONOMY LEVELS





11

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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12

12

Two Important Questions:

1. When will Transportation as a Service (TaaS) be available?
2. How quick will the transition be?



13

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

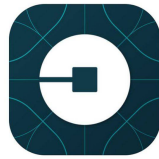
Elon Musk now expects first fully autonomous Tesla by 2019, approved by 2021



14

Wildly Optimistic, But...

40+ Corporations Working On Autonomous Vehicles



WAYMO



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15

15

WHEN?

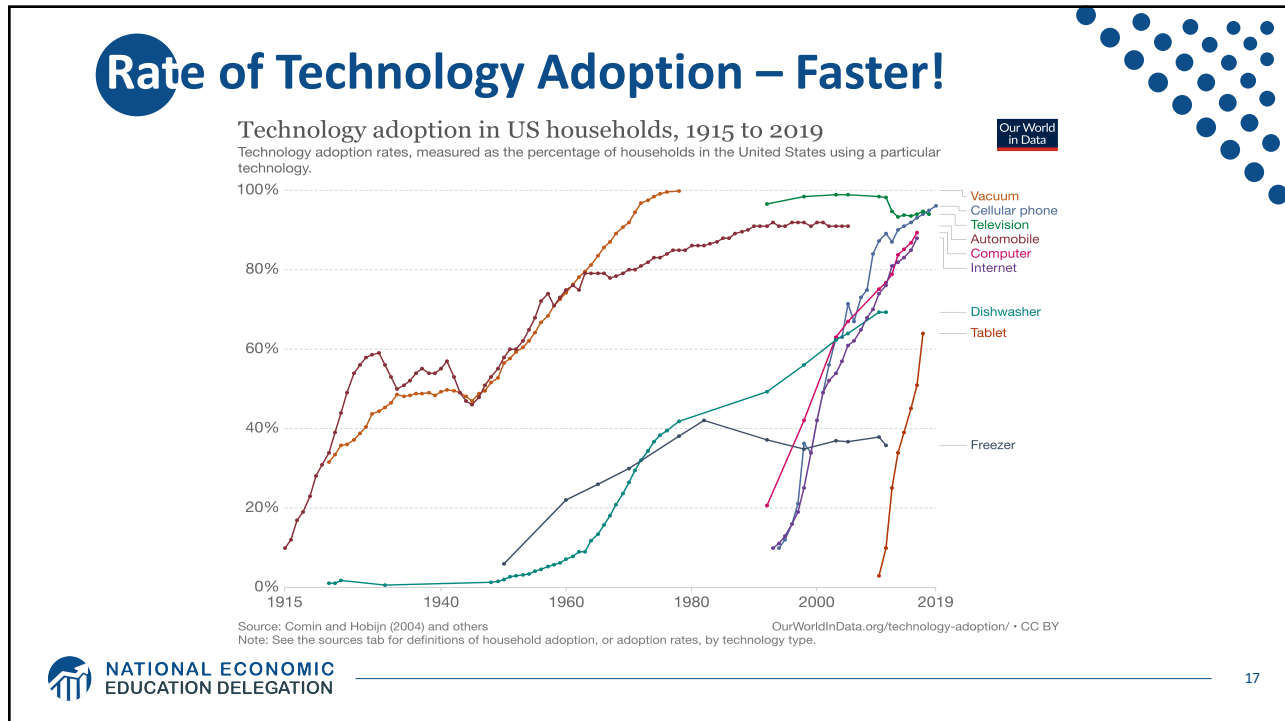
What is possible?

- By 2025 (?)
- Potentially 95% of VMT by 2035.
- Last 5% is going to 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.

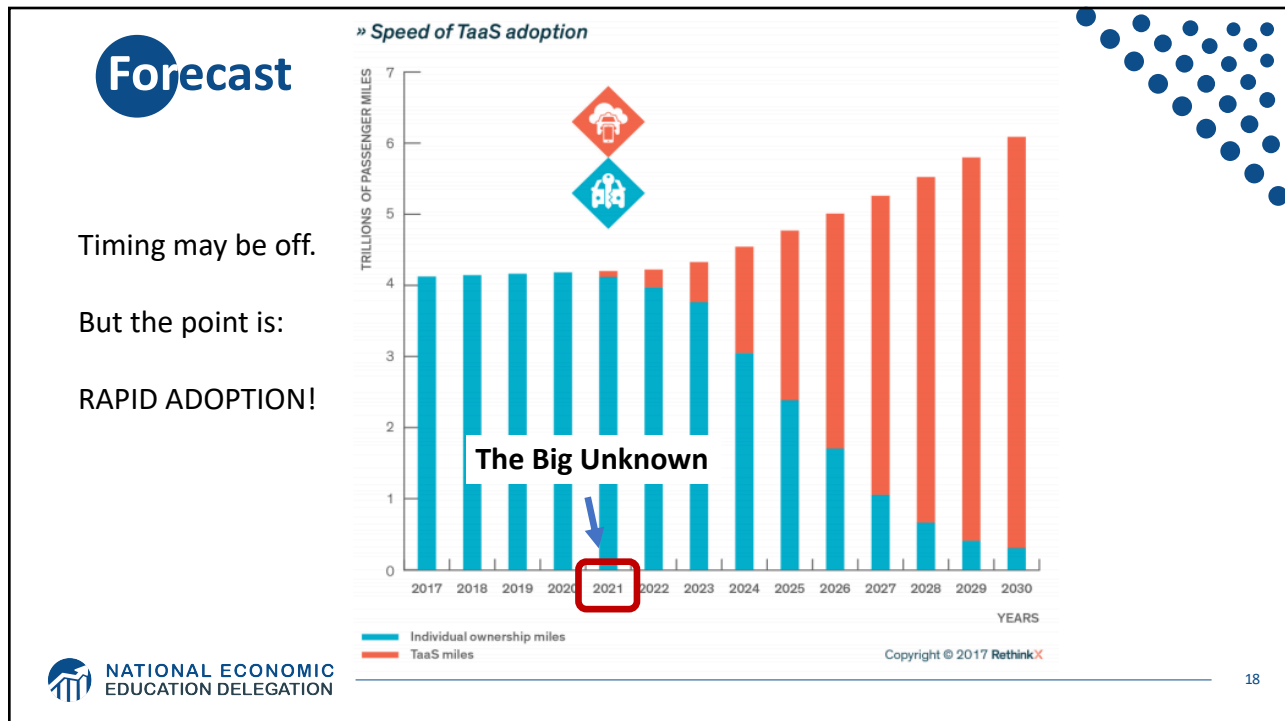


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16



17



18

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

Hyundai plans to launch a free robot taxi service in California

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

NuTonomy joins forces with 'the Uber of Southeast Asia'

Cruise to offer free robo-taxi rides in S.F. for the public — without backup drivers

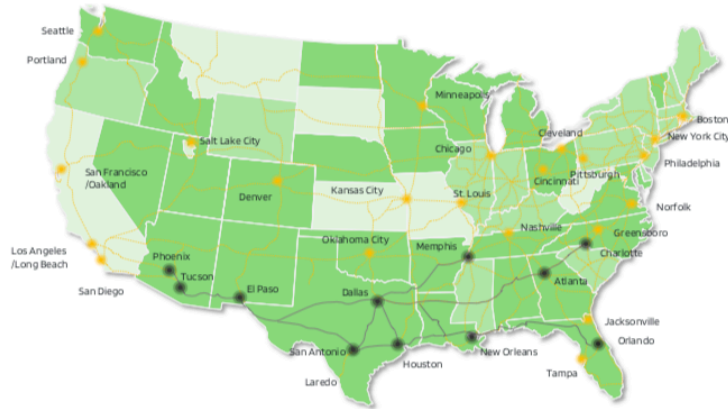
19

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.

20

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

AFN Network Expansion PlansTM

- Current Routes
- Future Expansion Plans

Regulatory Landscape

- L4 Autonomous Commercial Operations
- L4 Autonomous Testing
- In Progress



21

What will the future look like?



22

This:



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23

But, will it be:



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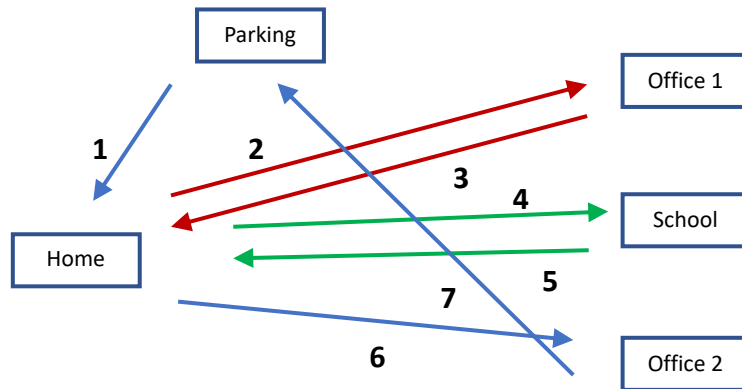
24

Hell

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



Two Adults and a Child: Morning Miles



And this is just the morning.....

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.
- **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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28

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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29


Economics Drives Transition: Private

- **Adoption dividend for private individuals**
 - Eliminate car ownership
 - Ave annual cost of owning a car: \$9,561
 - Cost per mile will fall: \$0.64 to \$0.19
 - Repurpose your garage
 - \$50,000 from transition to bedroom

- **Time recovery**
 - 50% of Bay Area workforce has a commute in excess of 30 minutes.

Average Costs Per Mile

Miles per Year	10k	15k	20k
Average Cost	82¢	64¢	55¢



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Source: NEED Calculations and AAA Driving Cost Fact Sheet, 2020

30

Economics Drives Transition: Public

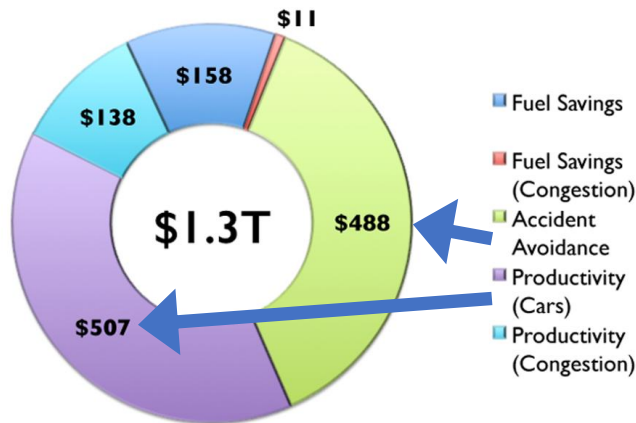
- **Economic and social costs associated with human drivers are enormous:**

- 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



Potential Savings

Potential US Savings (\$B)



Public Policy/Planning Issues

- **Government buy-in:**
 - Essential – gov't must encourage progress
 - Difficult – because of labor 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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34

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/impovertished
- **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.



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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



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37

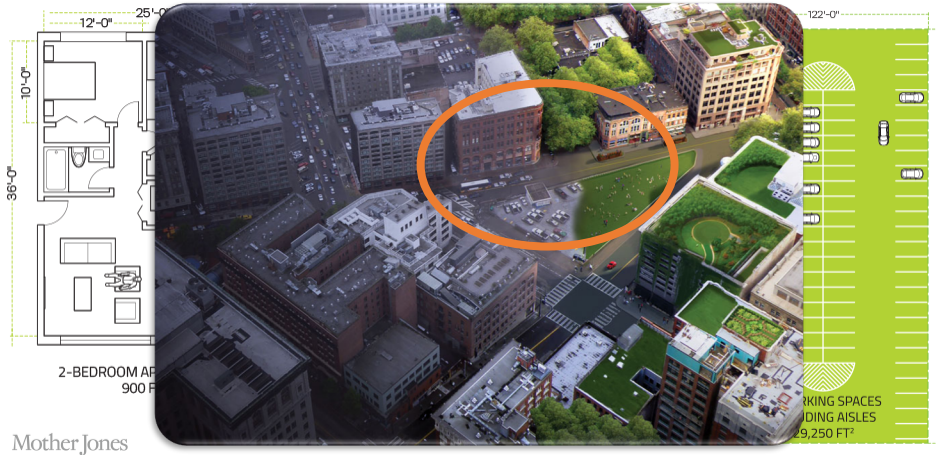
Safety and Productivity



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38

Environment



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

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

41

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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42

What Changes Will This Bring?

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

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



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Disposable Income



- Costs \$9,282 to own a car
- Will cost \$3,000 to use TaaS
- Net increase in disposable income of > \$6,000
- Spread across all households: more than \$1 trillion in new spending in the economy
- Major boost to economic activity
 - CREATING JOBS!



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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



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45

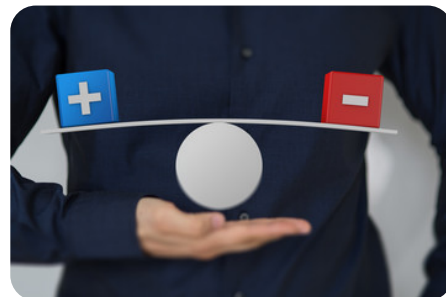
Transportation

- **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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46

Infrastructure

- **Focus of transportation infrastructure:**

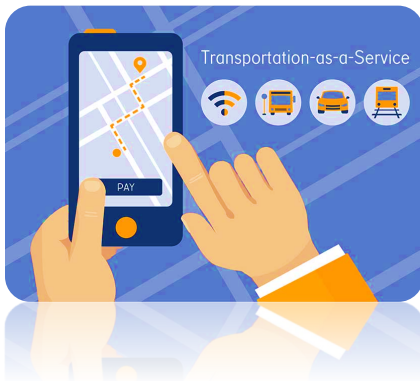
- Currently on expansion
- Will turn toward:
 - Maintenance
 - Signage and striping has to be robust
 - TaaS providers push for fewer potholes?
 - Adding technology
 - Stop lights will be digital as well as visual
- Some will disappear: Signs!



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47

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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48

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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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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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 fill parking lots that would 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).



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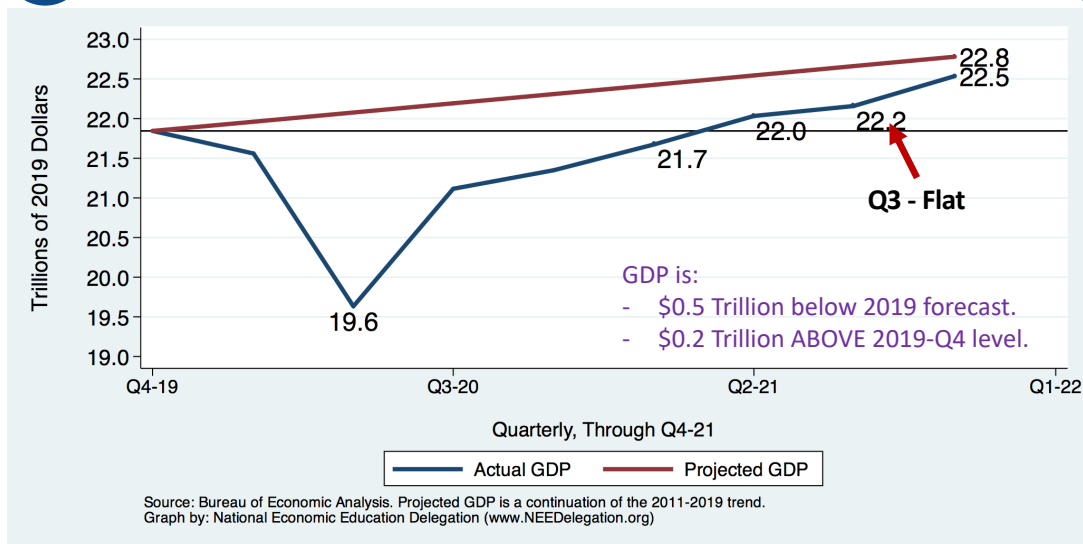
54

54

Summary of Change

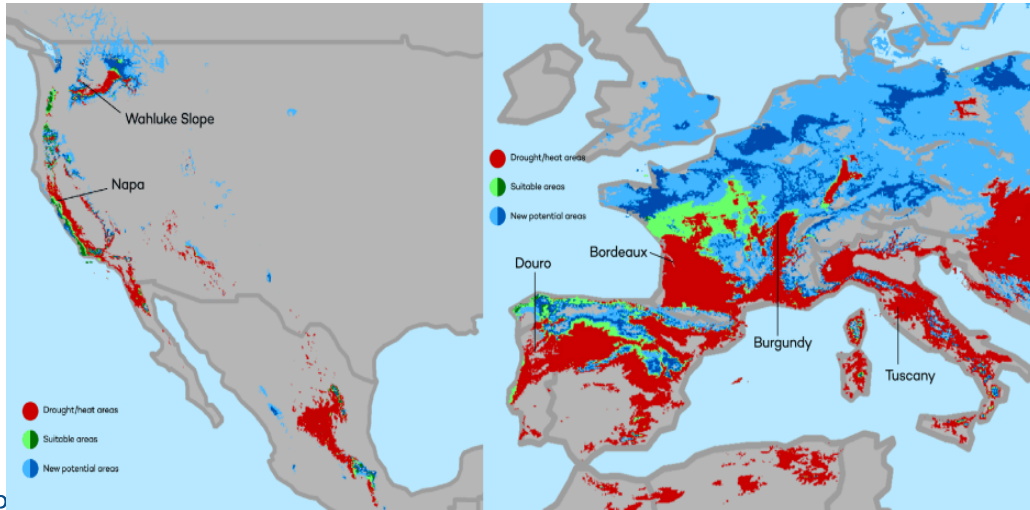
- Massive employment upheaval.
- Local government finances will look very different.
- Housing will be easier to build and more plentiful.
- Parking conversions will be commonplace.
- Demand for transportation infrastructure will likely decline.
 - Transportation infrastructure technology will be a booming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

GDP Trajectory: Pandemic Plunge!



Climate Change Economics

The changing map of the world's wine-growing regions.



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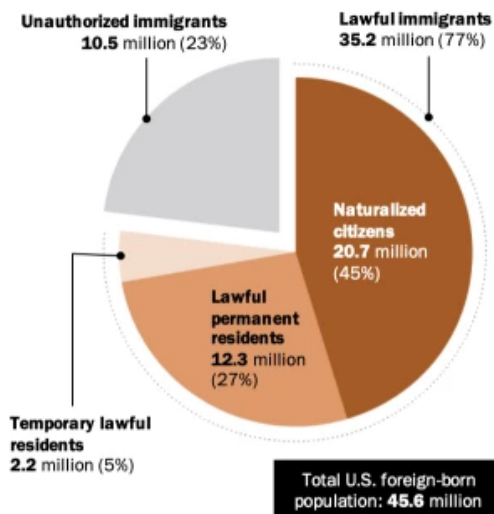
57

57

Immigrant Population in 2017

Foreign-born population estimates, 2017

Categories of the total number of immigrants in the United States.

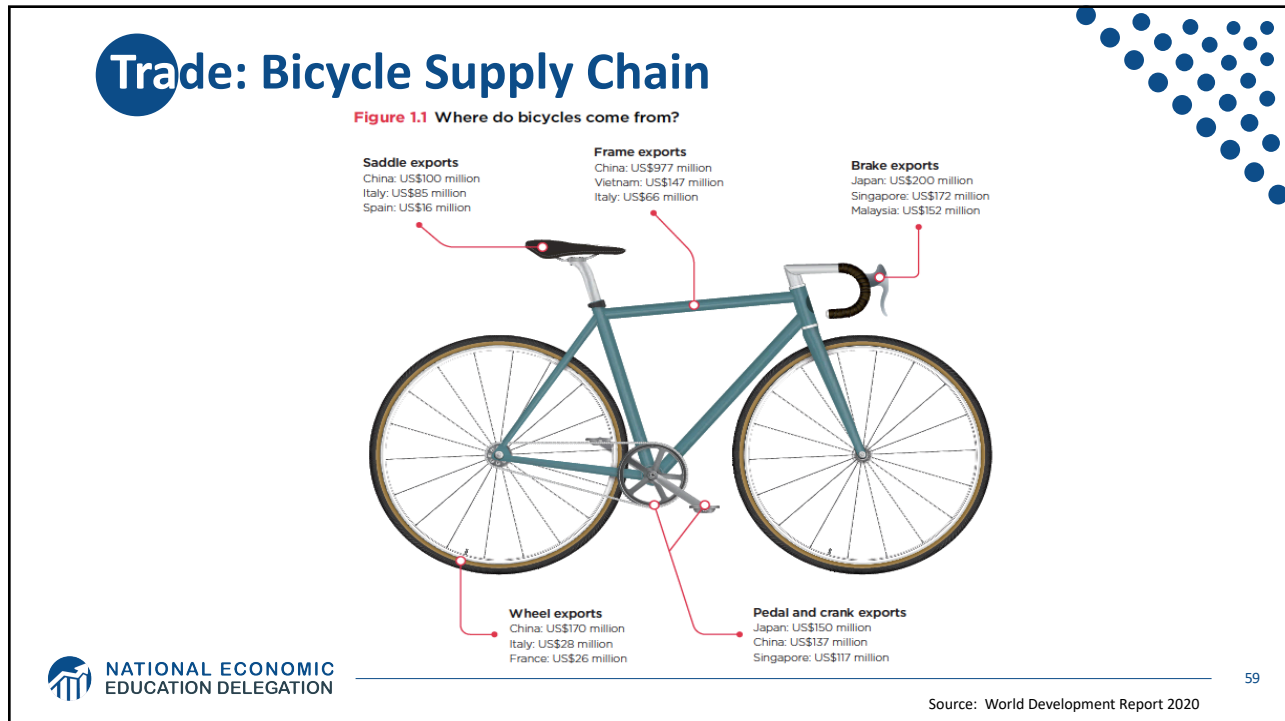


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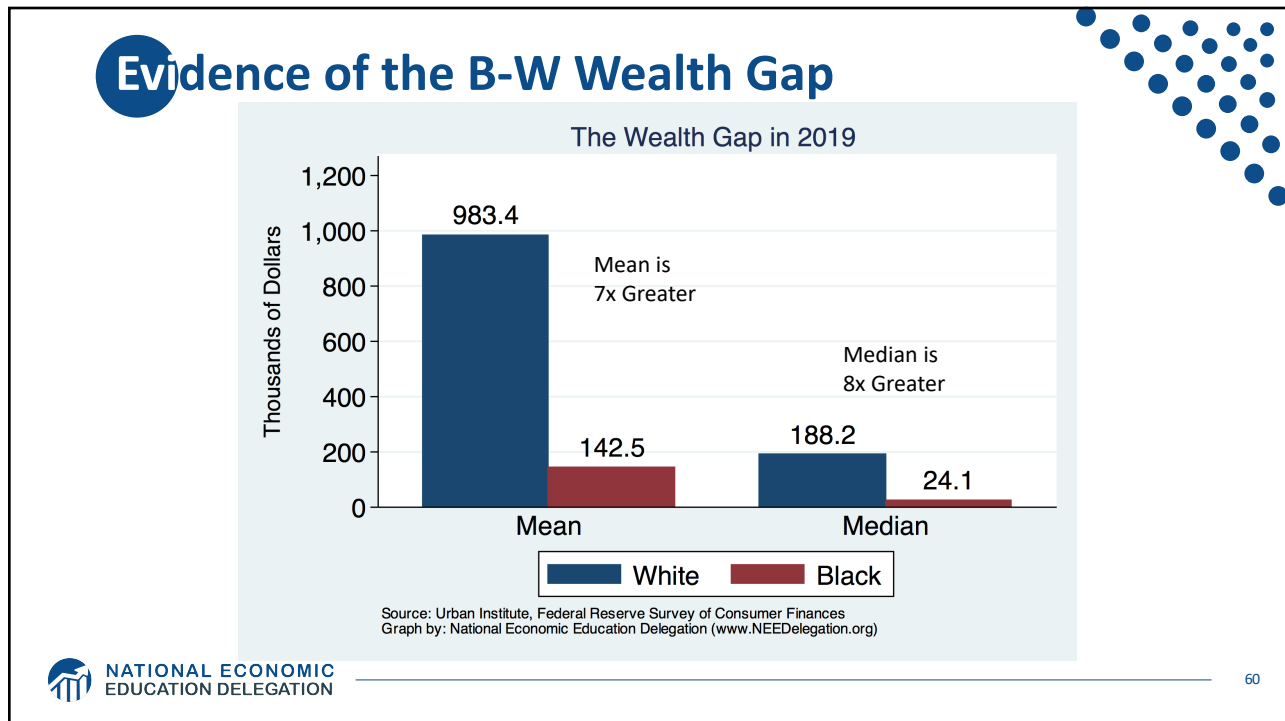
<https://www.pewresearch.org/fact-tank/2019/07/12/how-pew-research-center-counts-unauthorized-immigrants-in-us/>

58

58



59



60

Autonomous Vehicles



Thank you!

Any Questions?

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