NEED Public Webinar

Driving Change – Autonomous Vehicles' Big Impact

National Economic Education Delegation

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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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Who Are We?

- **Honorary Board: 48 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: 500+ 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: 45 Ph.D. Economists**
  - Aid in slide deck development

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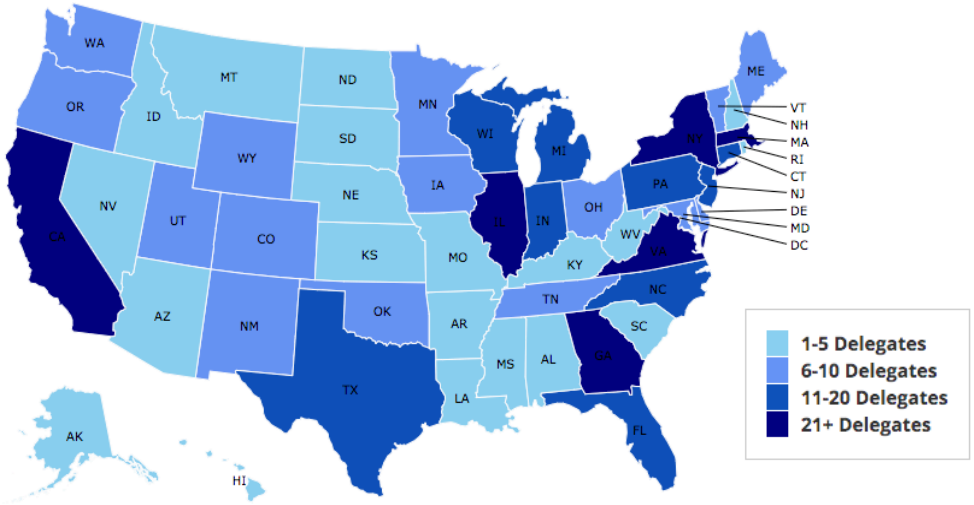
Where Are We?



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Available NEED Topics Include:

- Coronavirus Economics
- US Economy
- Climate Change
- Economic Inequality
- Economic Mobility
- Trade and Globalization
- Trade Wars
- US Social Policy
- Immigration Economics
- Housing Policy
- Federal Budgets
- Federal Debt
- 2017 Tax Law
- Autonomous Vehicles

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Credits and Disclaimer

- **This slide deck was authored by:**
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- **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

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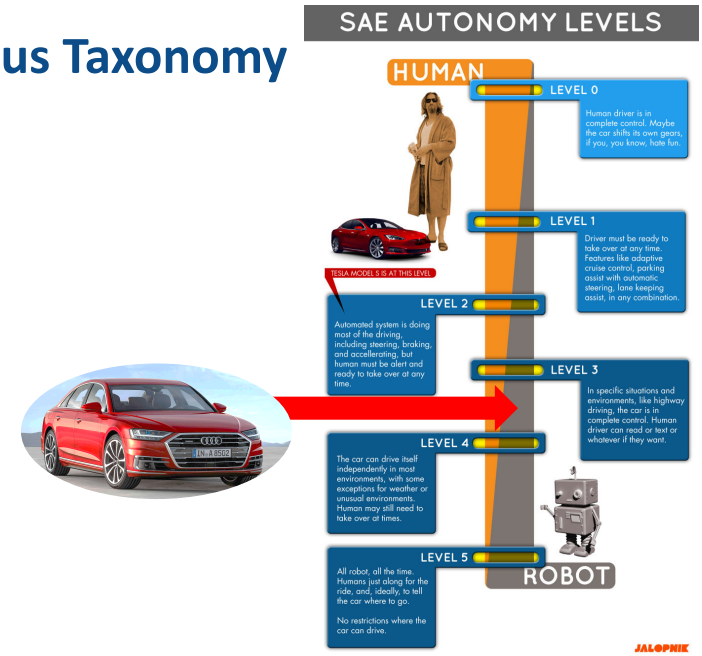
Autonomous Taxonomy



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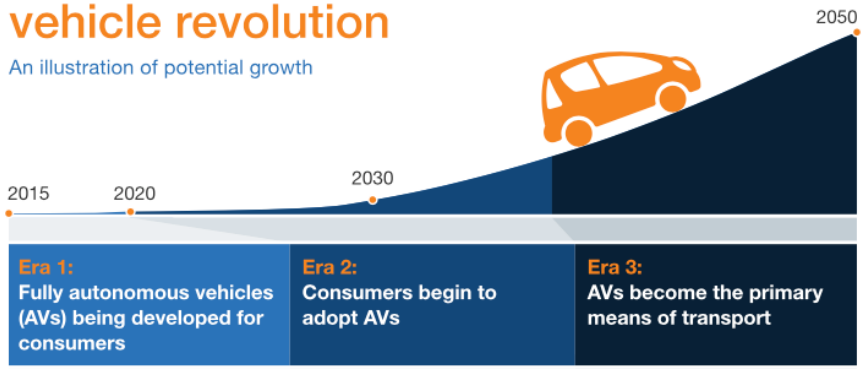
Growth Path



McKinsey & Company

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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

    Less than 1% of the actual figure: **109 Million**."
    - Professor Angel Lozano, 2014

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Two Important Questions:

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

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WHEN?
What do the headlines say?

NVIDIA to introduce level-4 enabling system by 2018

Audi to introduce a self-driving car by 2020

Volkswagen expects first self driving cars on the market by 2019

First autonomous Toyota to be available in 2020

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

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Wildly Optimistic, But…

40+ Corporations Working On Autonomous Vehicles

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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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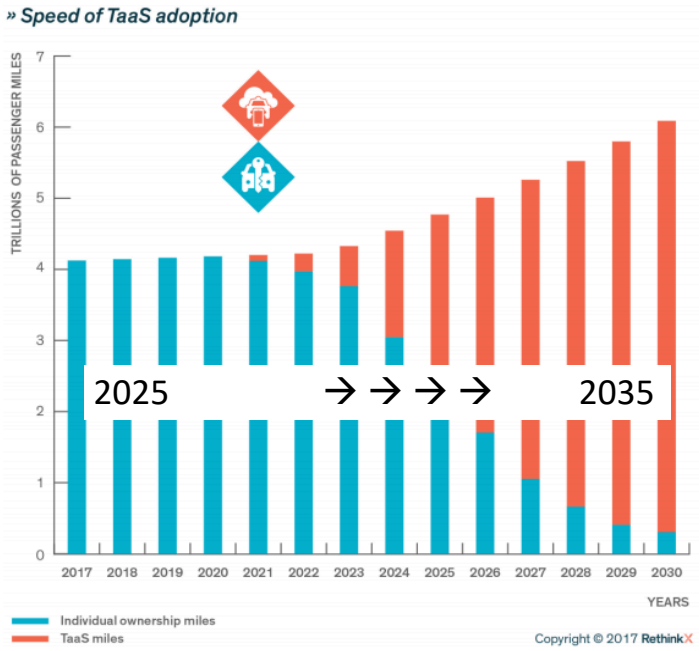
Forecast

Timing may be off.

But the point is:

RAPID ADOPTION!



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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'

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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
- **Combustion engines**
- **Why Hell?**
  - Dramatically increased VMT and pollution
  - Potentially increased congestion
  - Parking

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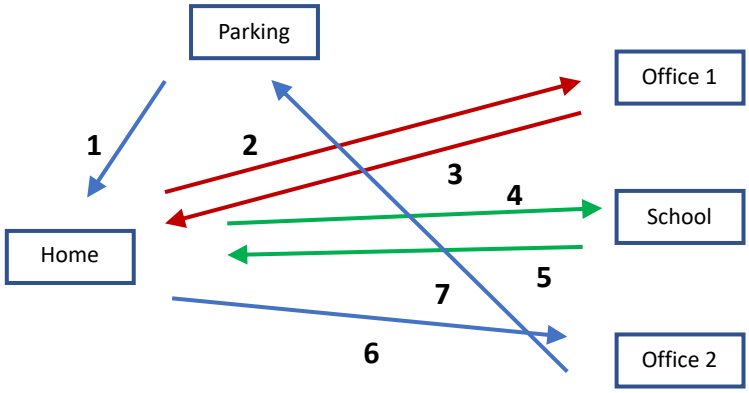
Two Adults and a Child: Morning Miles



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.
- **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: $9,282
    - Cost per mile will fall: $0.59 to $0.19
  - Repurpose your garage
    - $50,000 from transition to bedroom
- **Time recovery**
  - 50% of SF Bay Area workforce has a commute in excess of 30 minutes
- **It will become too annoying to drive around all of those autonomous vehicles!**

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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
  - Costs of human drivers estimated at $0.8 to $1.3 **TR**illion each year

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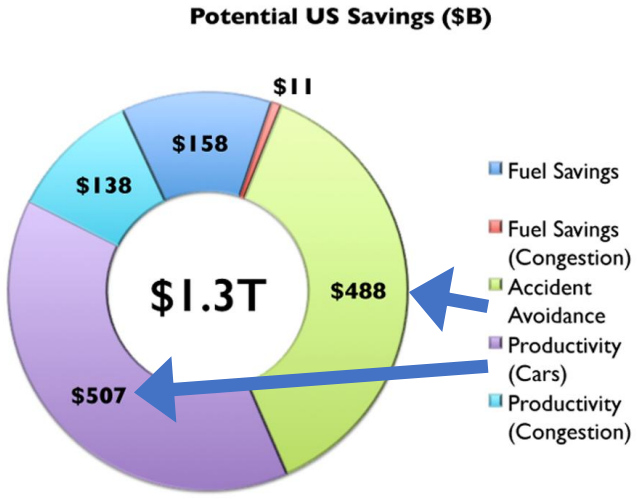
Potential Savings



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Morgan Stanley

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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**
  - Adjust the planning horizon for any investment in transportation infrastructure.
    - It may have gotten **MUCH shorter.**
- **Encourage the changes to happen more quickly**
  - Mobility, safety, productivity, and environmental benefits abound.

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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.

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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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Safety and Productivity

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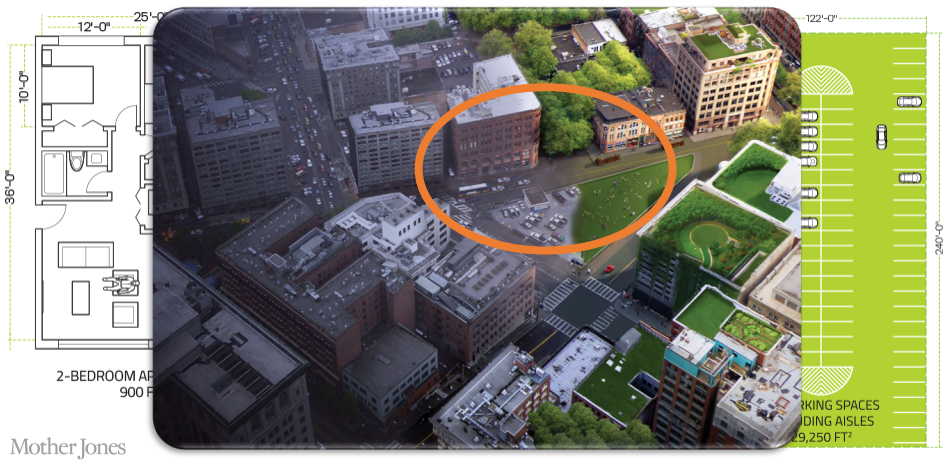
Environment



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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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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**
- **Employment**
- **Government Finances**
- **Transportation**
- **Public Transportation**
- **Infrastructure**
- **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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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…

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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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Government Finances

- **Government finances thrown for a loop:**
  - Revenues up and down:
    - Parking, tickets, traffic violations
    - 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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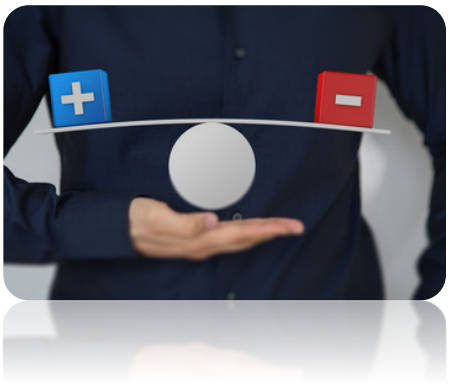
Transportation

- **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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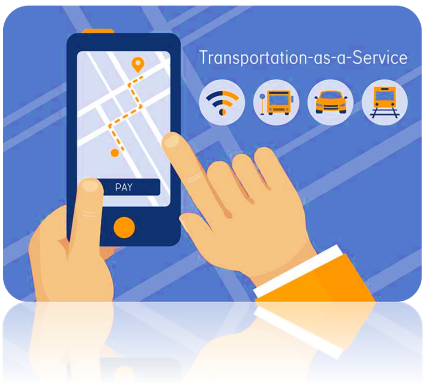
Public Transportation



- **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:**

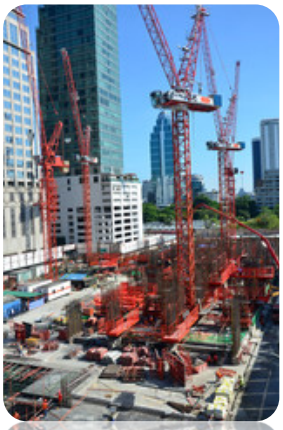
"The increasing dominance of cars was also felt by railway companies, which by June 1894 had to start making **pricing concessions** for transporting goods, even including free transport."

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

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!

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 60 miles.
    - California's entire coastline is 840-miles.
- **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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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**

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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

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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Coronavirus and the Autonomous Vehicle

- **Unknown, but likely a slowing force.**
- **Much technology development can continue.**
- **On-street testing has likely slowed.**
  - Certainly ride sharing services have ceased.
- **Transit agencies will be strapped for cash.**
  - Slowing their ability to respond to industry demands.

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Thank you!

Any Questions?

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