

San Rafael Public Library

Driving Change – Autonomous Vehicles’ Big Impact

National Economic Education Delegation

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1

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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2

2

Who Are We?

• Honorary Board: 47 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: 487 members

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

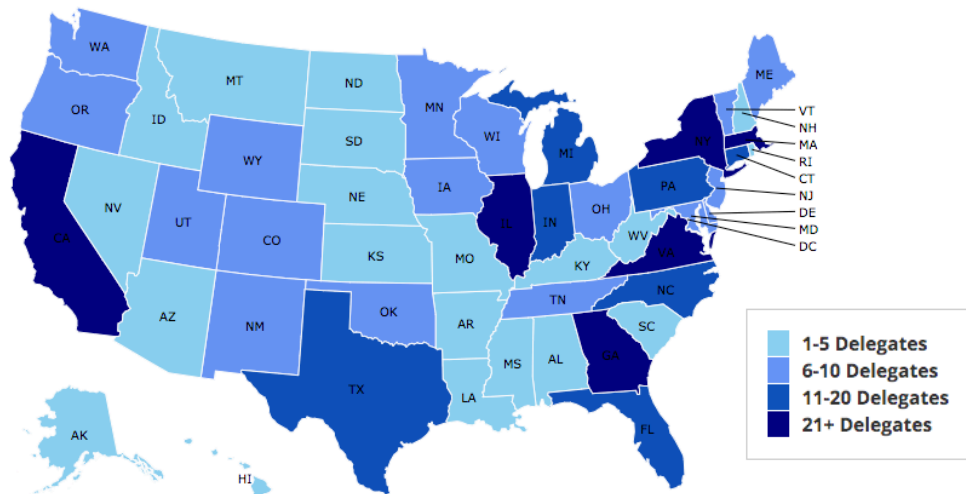
• Global Partners: 45 Ph.D. Economists

- Aid in slide deck development



3

Where Are We?



4

NEED Presentation Topics

- US Economic Update
- Trade and Globalization
- Trade Wars
- Climate Change Economics
- Economic Inequality
- Economic Mobility
- Economics of Immigration
- Housing Policy
- Government Budgets and Debt
- Autonomous Vehicles

5

Autonomous Vehicles

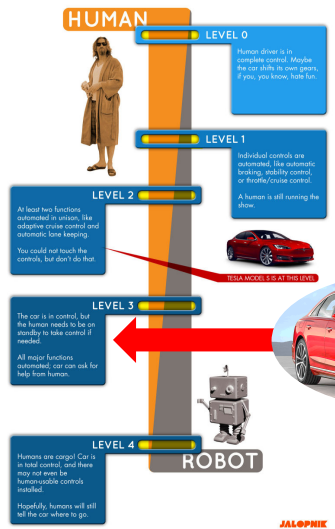
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Outline

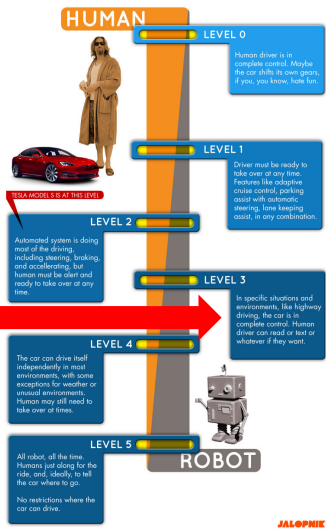
- Where does the AV path lead?
- Transition
- Policy/Planning Issues
- Major Economic/Development Changes
- Environmental Implications

7

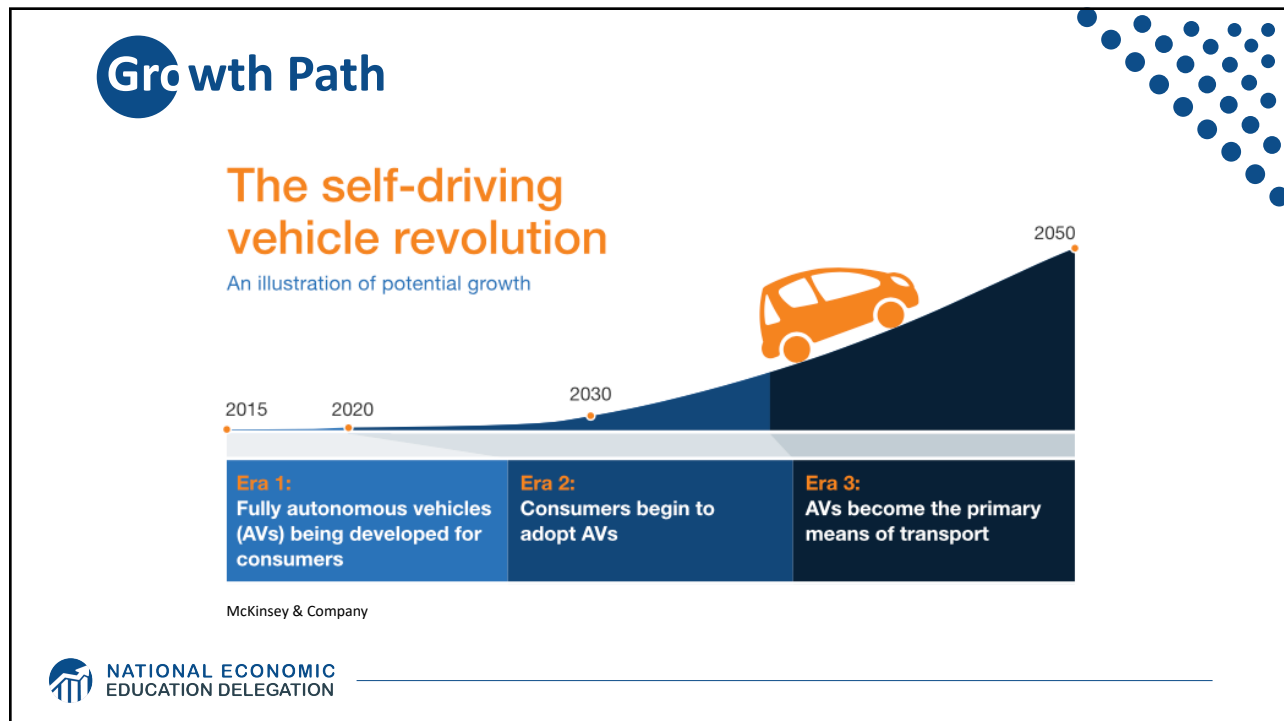
NHTSA AUTONOMY LEVELS



SAE AUTONOMY LEVELS



8



9

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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10

10

Two Important Questions:

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

11

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

12

Wildly Optimistic, But...
40+ Corporations Working On Autonomous Vehicles

Apple, Google, Waymo, GM, Lyft, Tesla

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13

13

Wildly Optimistic, But...
40+ Corporations Working On Autonomous Vehicles

Volkswagen, Intel, Mobileye, KIA

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14

14

WHEN? What is possible?

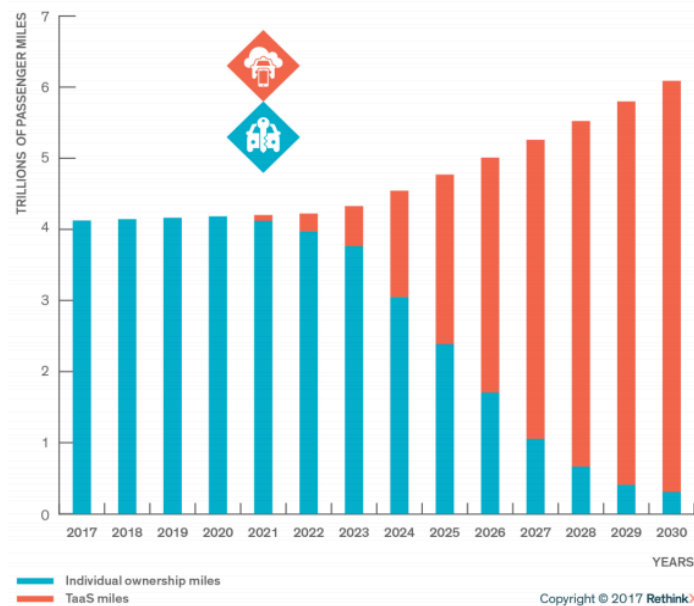
- By 2025
- Potentially 95% of VMT by 2035.
- Last 5% is going to be very difficult to achieve.
- Is this possible?
 - Horses to cars: 10 years – early 1900s
 - But adoption of EVs is so slow!
 - Adoption of AVs will be rapid.



Forecast

Timing may be off.
But the point is:
RAPID ADOPTION!

» Speed of TaaS adoption



Waymo is Offering Driverless Services

Alphabet Inc.'s Waymo took a big step forward last fall (2019) when it began ferrying riders around the Phoenix area in robotaxis without human safety drivers. (Bloomberg)



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'

What will the future look like?



19

This:



20

But, Will it be:



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21

Hell

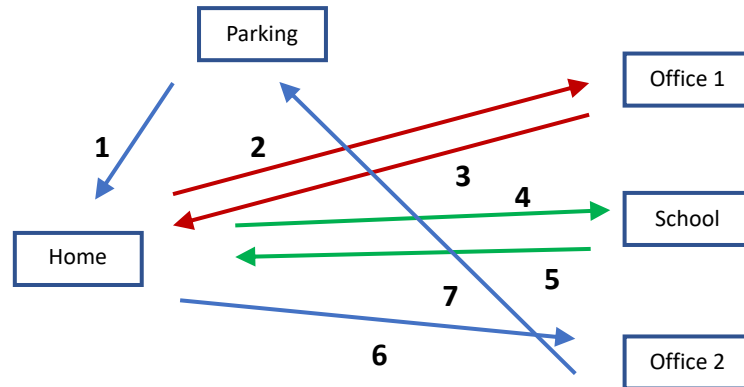
- **Primarily individual private car ownership**
 - Much as today
- **Combustion engines**
- **Why Hell?**
 - Dramatically increased VMT and pollution
 - Potentially increased congestion
 - Parking



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Two Adults and a Child: Morning Miles



And this is just the morning.....



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23

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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26

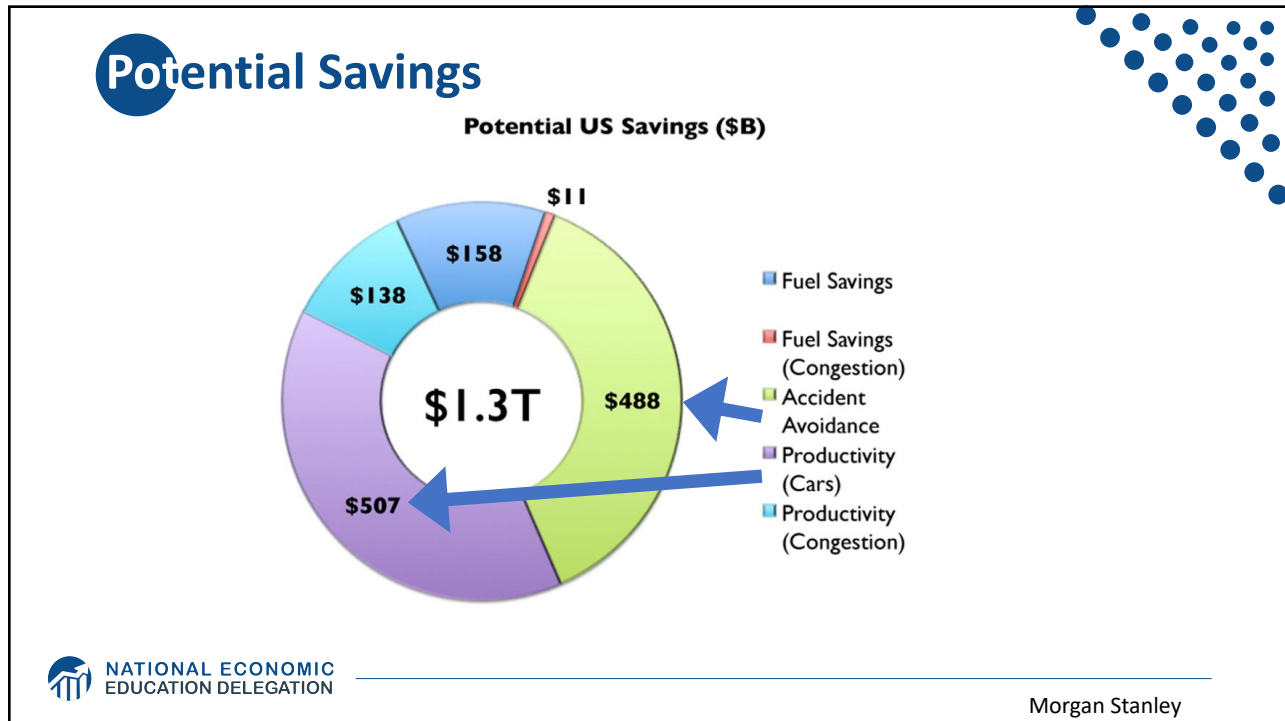
Economics Drives Transition: Private

- **ADOPTION DIVIDEND for private individuals**
 - Eliminate car ownership
 - Ave annual cost of owning a car: \$9,576
 - Cost per mile will fall: \$0.59 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.
- **It will become too annoying to drive around all of those autonomous vehicles!**

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 TRillion each year





29

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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 Morgan Stanley

30

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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31

Encourage Change

- **Mobility and equity considerations**
 - Elderly/disabled/impooverished
- **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**

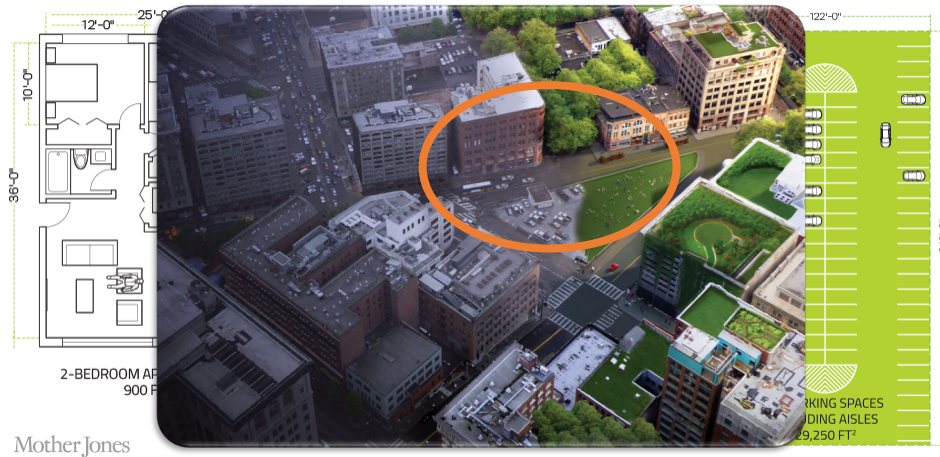
- Public Transportation often does not work well for low income workers/residential workers
 - Does not go from residential to residential, but from residential to commercial



Safety and Productivity



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.**
 - Sacrifice expansion for maintenance.



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What Changes Will This Bring?

- | | |
|------------------------------|--------------------------------|
| • Disposable Income | • Public Transportation |
| • Employment | • Infrastructure |
| • Government Finances | • Housing |
| • Transportation | • Parking |

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



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Disposable Income



- Costs \$9,576 to own a car
- Will cost \$3,000 to use TaaS
- Net increase in disposable income of > \$6,000
- \$1 trillion in new spending in the economy.
- Major boost to economic activity
 - CREATING JOBS!

Employment

- **Massive job displacement/relocation (Millions!):**
 - Drivers of all varieties: truck, taxi, delivery...
 - Car and 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**



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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

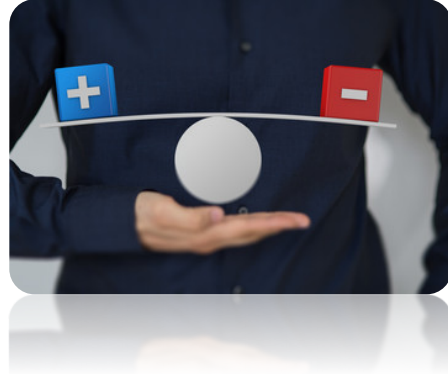


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42

Transportation

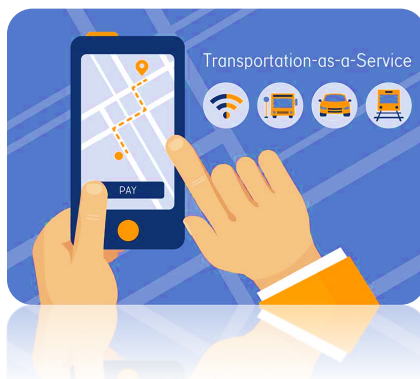
- **Demand for transportation will likely increase significantly:**
price falls, demand rises
 - Commutes may increase in distance, but not necessarily in duration
 - Zero passenger trips will arise
 - Deliveries
- **At the same time, demand for roadway lane-miles will likely decrease**
 - AVs make significantly 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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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 networked as well as visual



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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.

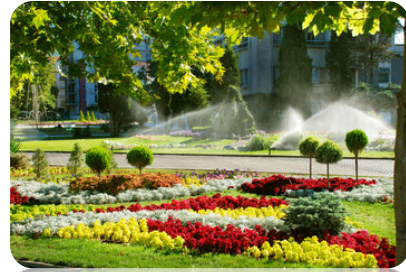


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Parking

- **With transportation as a service (TaaS), there will be minimal demand for parking lots**
- **Service providers will own lots in strategic places, but likely 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 longer than California's entire 840-mile coastline
 - 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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48

48

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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49

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

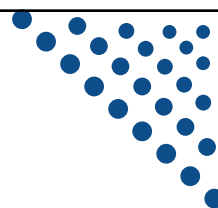
Bottom line: push governments at all levels to embrace and to implement policies deterring private vehicle ownership and zero passenger miles



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50

Thank you!



Any Questions?

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