

*Marvelous Marin Breakfast Club*

# Driving Change – Autonomous Vehicles’ Big Impact

National Economic Education Delegation

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*September 12, 2019*



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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: 44 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: 365 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: 42 Ph.D. Economists**

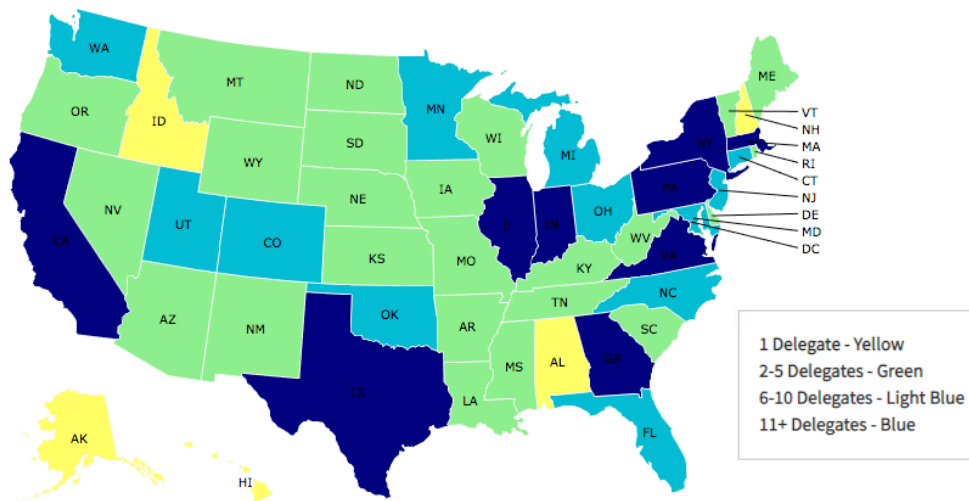
- Aid in slide deck development



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3

## Where Are We?



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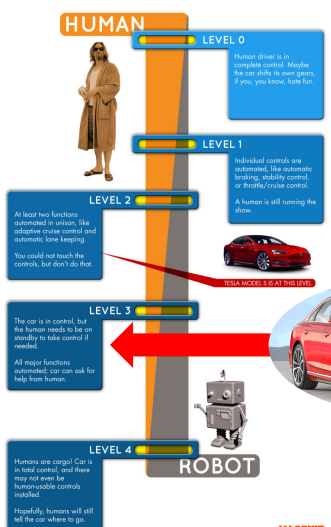
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# Outline

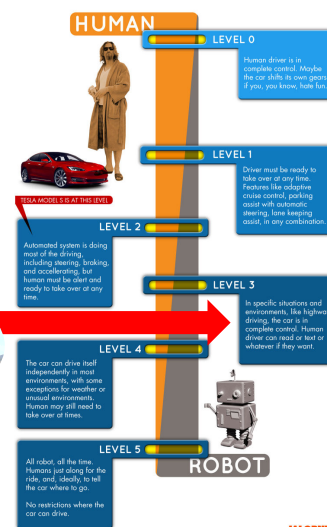
- Where does the AV path lead?
- Transition
- Policy/Planning Issues
- Major Economic/Development Changes
- Environmental Implications

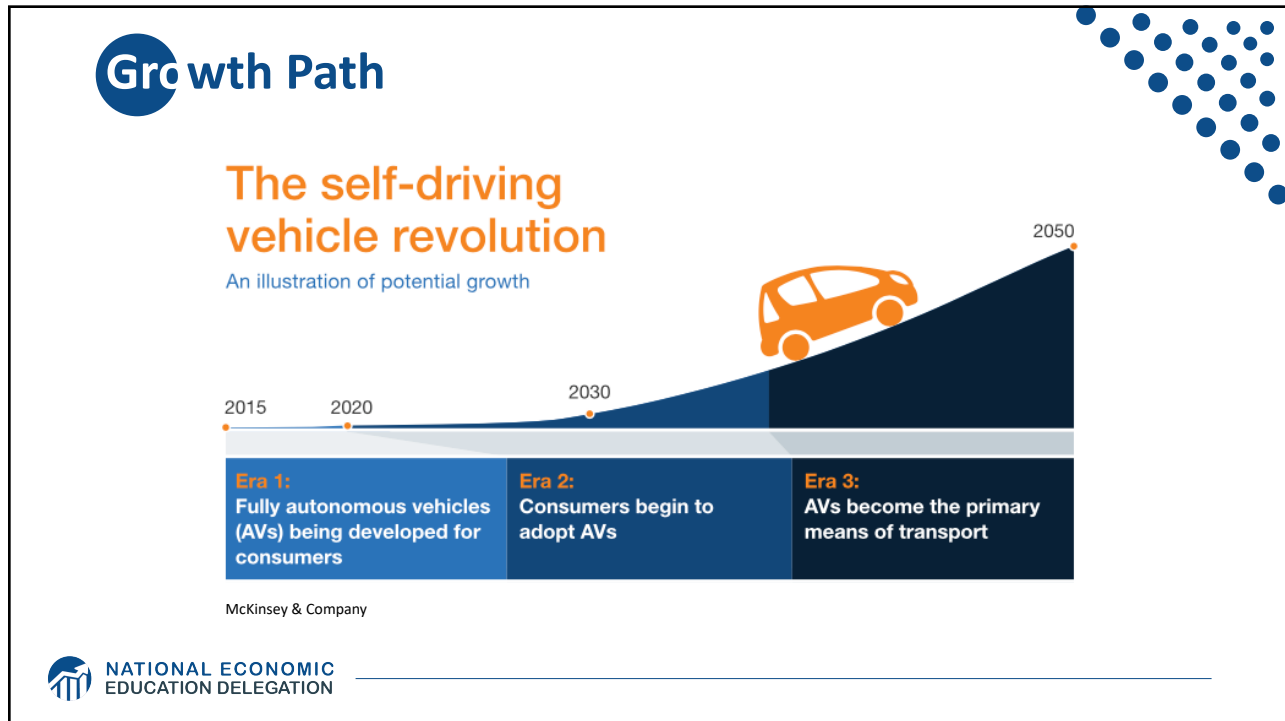


## NHTSA AUTONOMY LEVELS



## SAE AUTONOMY LEVELS





## WHEN?

### What do the headlines say?

**NVIDIA**

NVIDIA to introduce level-4 enabling system by 2018

**TOYOTA**

First autonomous Toyota to be available in 2020

**Audi**

Audi to introduce a self-driving car by 2020

**Volkswagen**

Volkswagen expects first self driving cars on the market by 2019

**TESLA MOTORS**

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

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# WHEN?

## What is possible?

- Potentially 95% by 2030
- 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



# What will the future look like?

**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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## 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.**
  - Fewer zero passenger miles driven.
- **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: \$9,576
    - 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!**



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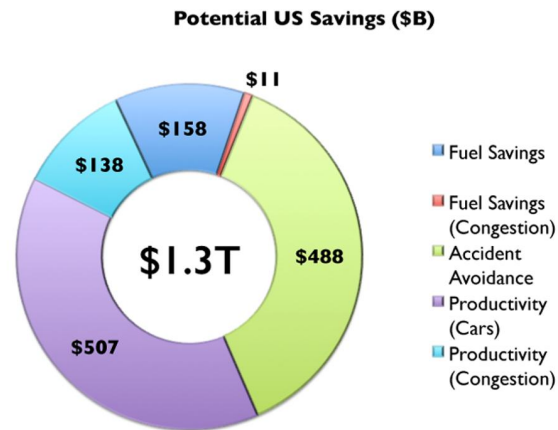
## Economics Drives Transition: Public

- **Economic and social costs associated with human drivers are enormous:**
  - Estimated at \$0.8 to \$1.3 **TR**illion each year
  - Accidents drive 25% of congestion
  - 40,000 deaths from car accidents
  - 2 million injuries
  - 90+% of accidents caused by human error



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## Potential Savings



## 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.

## 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



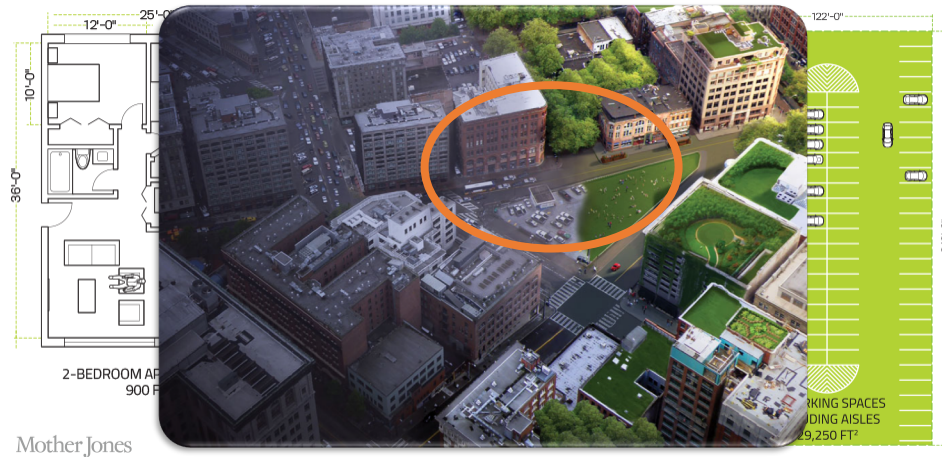
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## Safety and Productivity



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



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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**

## 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

## Overall Summary

- **There is an enormous upside to autonomous vehicles**
  - Many private benefits.
  - Also positive externalities – public benefits.
- **There is also a potential downside: Hell**
- **The role of government?**
  - Promote the development of autonomous vehicles.
    - Reap the public benefits.
  - Ensure heaven and not hell.
- **When they arrive....nobody knows!**



Thank you!

## Any Questions?

[www.NEEDelegation.org](http://www.NEEDelegation.org)

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