

*San Francisco Economic Roundtable*

# Driving Change – Autonomous Vehicles’ Big Impact

National Economic Education Delegation

Jon Haveman, Ph.D.

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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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## 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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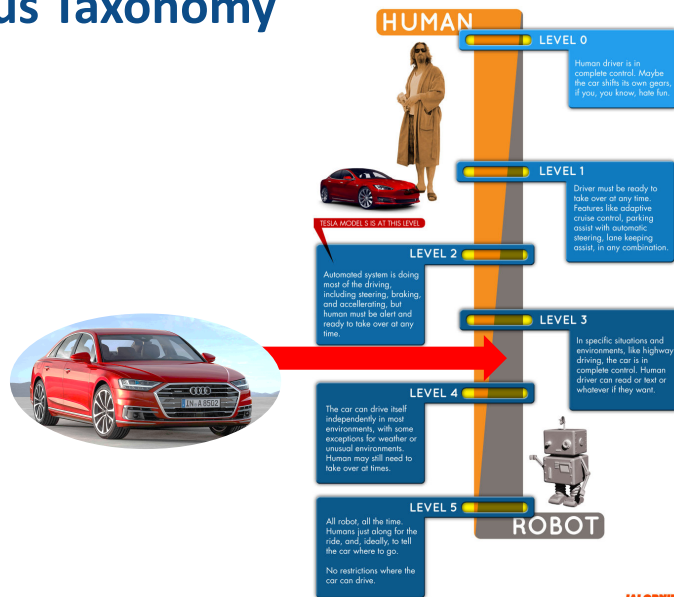
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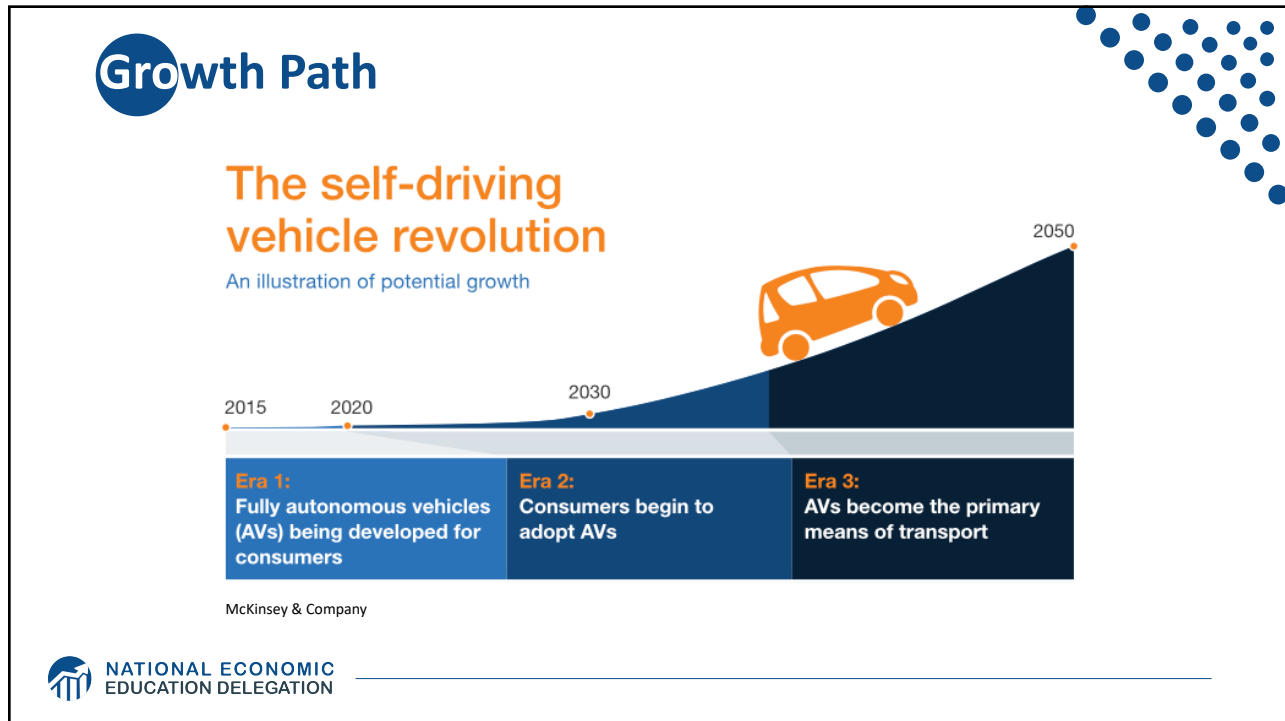
# Outline

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

# Autonomous Taxonomy

## SAE AUTONOMY LEVELS





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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



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**

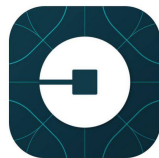
Elon Musk now expects first fully autonomous Tesla by 2019, approved by 2021



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# Wildly Optimistic, But...

## 40+ Corporations Working On Autonomous Vehicles



WAYMO



**TESLA**



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# WHEN?

## What is possible?

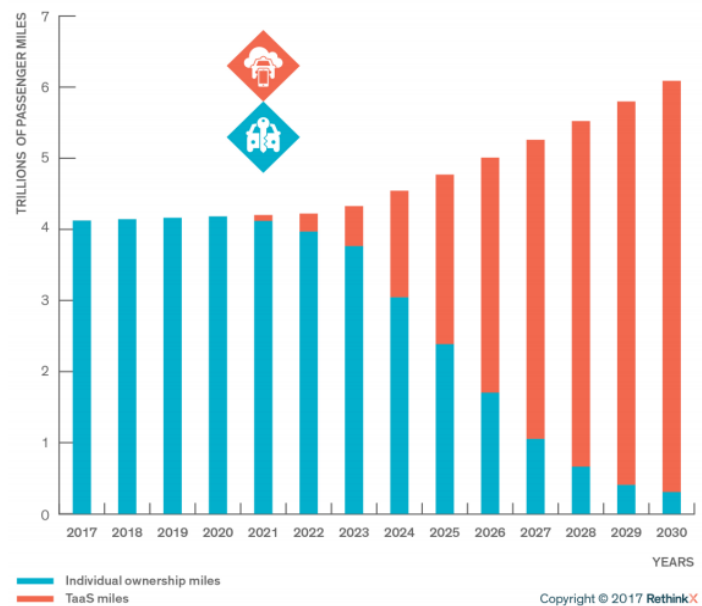
- By 2025
- Potentially 95% of VMT by 2035.
- Last 5% is going to be very difficult to achieve.
- Is this possible?
  - Horses to cars: 10 years – early 1900s
  - But adoption of EVs is so slow!
  - Adoption of AVs will be rapid.



# Forecast

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

» Speed of TaaS adoption



# 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

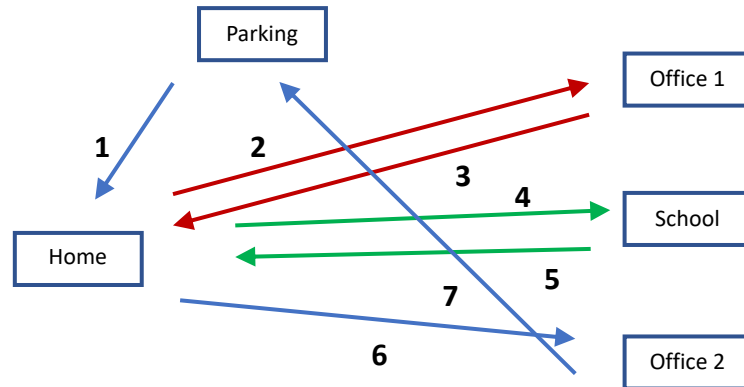


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## Two Adults and a Child: Morning Miles



*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 Bay Area workforce has a commute in excess of 30 minutes



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## Economics Drives Transition: Public

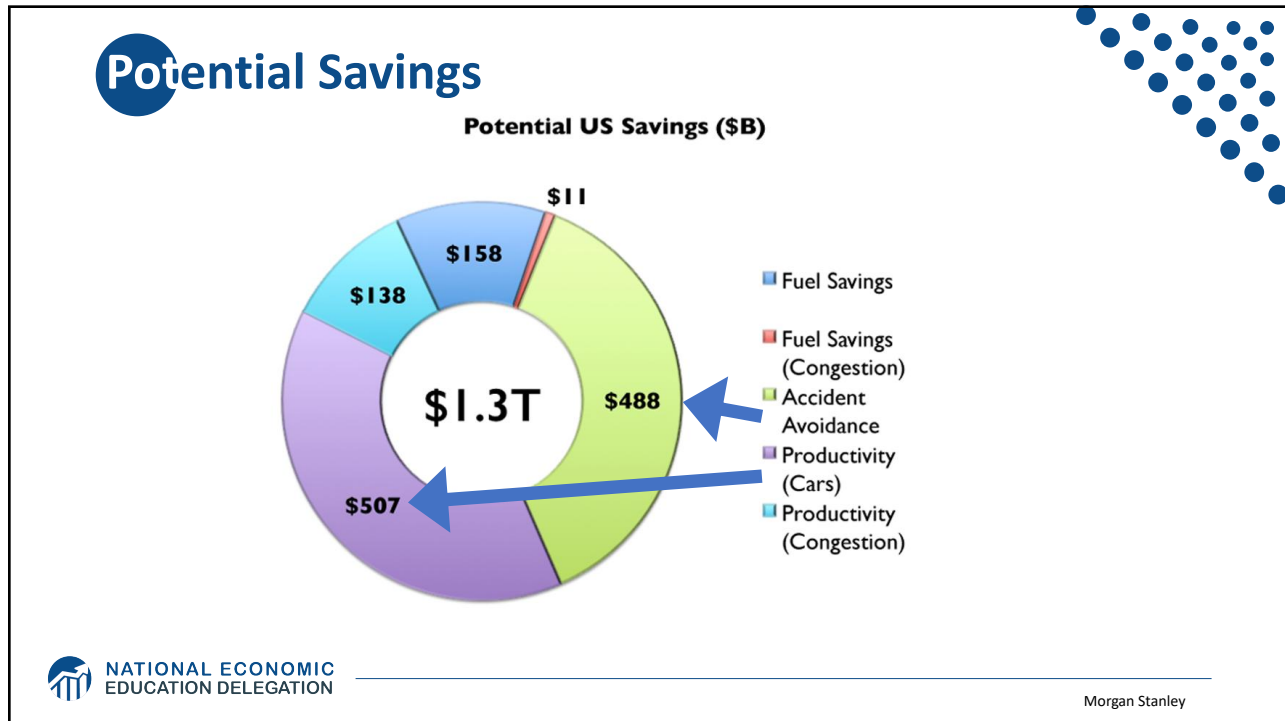
- **Economic and social costs associated with human drivers are enormous:**

- 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 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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  Morgan Stanley

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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

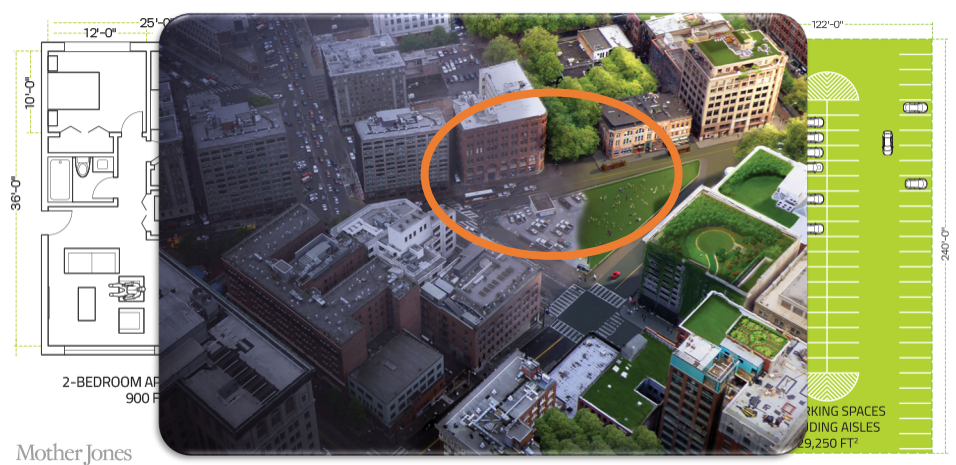


# Safety and Productivity



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# Environment



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## 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
- Government Finances
- Transportation
- Infrastructure
- Employment
- Housing
- Public Transportation
- Parking

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



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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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## Housing



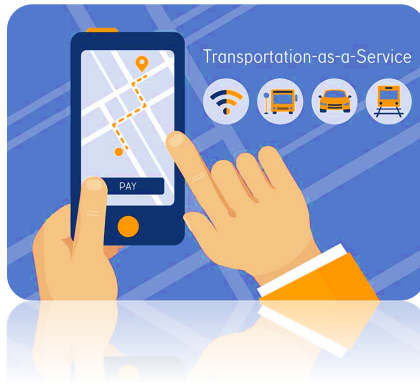
- **Housing is suddenly easier to build.**
  - Issue of traffic congestion is significantly reduced.
  - Space for new housing is available where parking lots used to be.
- **Existing houses can now accommodate more people: garage to bedroom conversions.**



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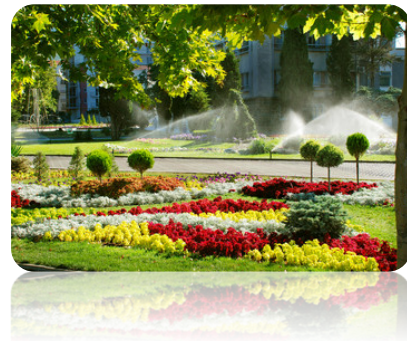
## Public Transportation



- **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**

## 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.**



## 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).



## 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.**



# 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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Jon Haveman, Ph.D.

Jon@NEEDelegation.org

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