WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

Washington State Transportation Commission

AV Work Group Executive Committee Meeting

May 25, 2021

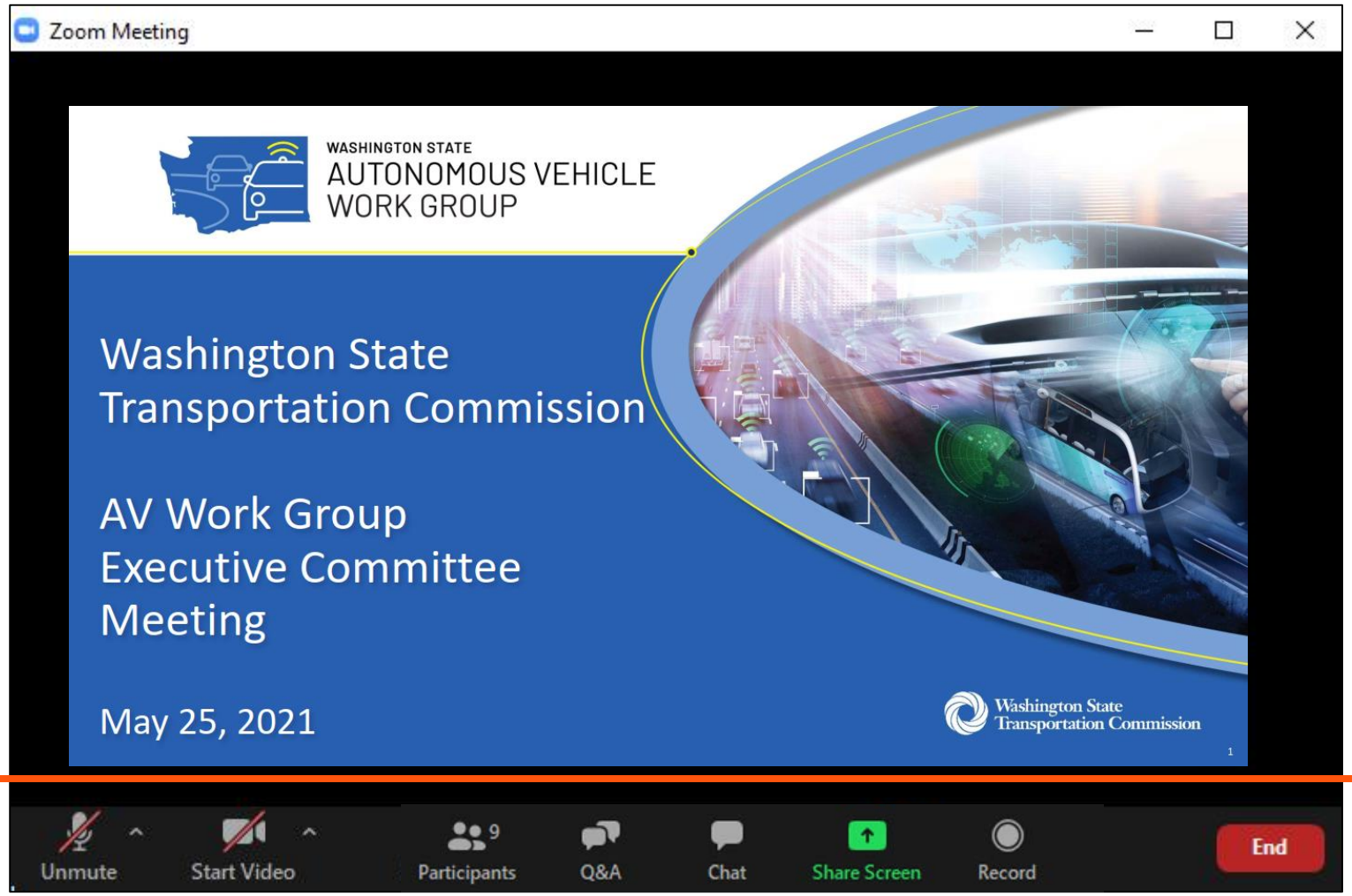
Washington State Transportation Commission

Agenda

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

TIME	DESCRIPTION	
9:00	**Welcome & Introductions**	**Jim Restucci**, Chair, *AV Work Group Executive Committee*
9:10	**Legislative Update**	**Reema Griffith**, Executive Director, *Washington State Transportation Commission*
9:20	**University of Washington AV National Research Update**	**University of Washington Technology and Public Policy Clinic Students** Kristen Moran, Daniel Ballesteros, Dylan Harlow, Savannah McKinnon, Lorena Lung, Mason Hudon
10:15	**AV Freight Mobility Panel**	**Kyle Quinn**, Chief Technology Officer, *PACCAR* **Alison Cochran**, PACCAR Technical Lead, AVP, *PACCAR* **Darryl Oster**, Chief Engineer, Zero Emissions, *PACCAR* **Kenny Quinn**, Technical Program Manager, Partner Products & Programs, *Aurora* **Mufaddal Ezzy,** Director, Public Affairs and State & Local Government Relations, *Aurora* **Ross Froat**, Director of Technology and Engineering Policy, *American Trucking Association*
11:45	***LUNCH BREAK***	***30 MINUTES***
12:15	**The State of AV Testing & Utah Use Case**	**Blaine Leonard**, Transportation Technology Engineer, *Utah Department of Transportation* **Scott Shogan**, Vice President, *WSP USA*
1:20	**Future Path Update and Discussion**	**Scott Shogan**, Vice President, *WSP USA*
2:15	**Executive Committee Member Items**	*Open forum for members*
2:25	**Closing Remarks**	**Jim Restucci**, Chair, *AV Work Group Executive Committee*
2:30	**ADJOURN**	

Virtual Meeting Operations – Zoom Webinar



Executive Committee Members & Presenters

- You have the ability to **mute/unmute yourself**, please stay on mute unless wishing to speak
- You are encouraged to **turn on your video**, especially during discussion periods
- You can **use the "Chat" box** to communicate with "panelists" - meeting hosts, committee members, and presenters
  - » NOTE: You do have the ability to send a chat to ALL ATTENDEES, *please do not use this feature*

The meeting controls bar may be on top, bottom, or sides of your screen

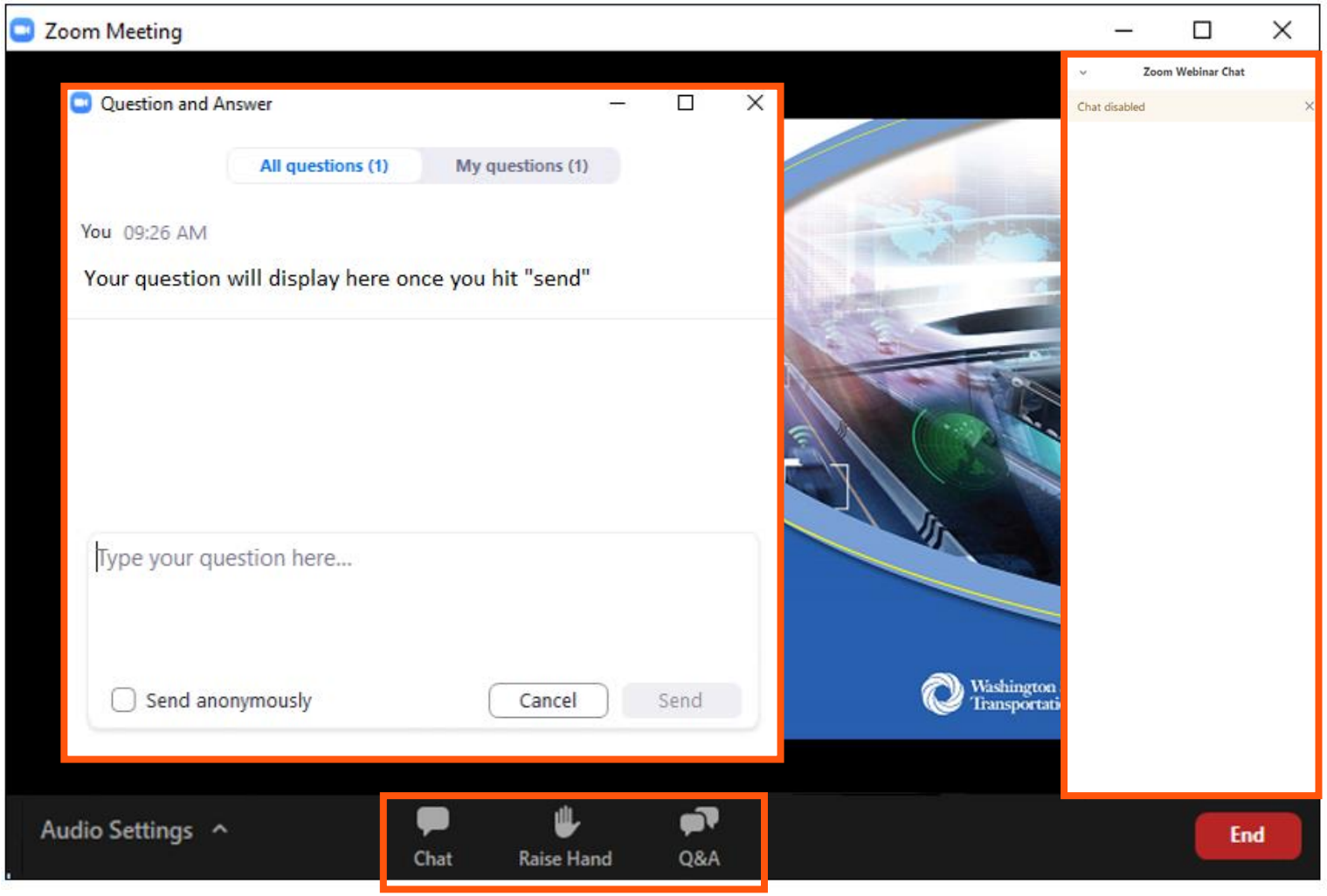
Virtual Meeting Operations – Zoom Webinar

Executive Committee Members & Presenters

(continued)

- During discussion and Q&A periods:
  - Physically **raise your hand on your video**
  - OR
  - Pose a question in the **"Chat" box**
  - *Note you will not have the "Raise Hand" feature*
- You will be able to see questions in the Q&A box, but may not be able to pose a question – please physically raise your hand or use the "Chat" feature

Virtual Meeting Operations – Zoom Webinar



Other Attendees

- You will be **muted with no video capabilities** when you join
- The “Chat” feature is disabled
- **Use the “Raise Hand” feature** to request to be unmuted
- You can **use the “Q&A” box** to pose questions
  - » Organizers will read questions aloud during the Q&A period of each presentation

Virtual Meeting Operations – Zoom Webinar

Other Attendees

- Call-in participants **can still access the Q&A box,** if viewing the presentation online
- For those only calling in, you can **mute/unmute by pressing *6**
  - When not speaking, please ensure phone line is muted
- For those only calling in, you can **“Raise Hand” by pressing *9**

Legislative Update

Reema Griffith, *WSTC*
Executive Director

WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

Washington State
Transportation Commission

SCHOOL OF LAW

University of Washington Technology Law and Public Policy Clinic

Connected and Autonomous Vehicles Research Group

Washington State Transportation Commission: Final Report

Mason Hudon, Kristen Moran, Lorena Lung
Savannah McKinnon, Dan Ballesteros, Dylan Harlow

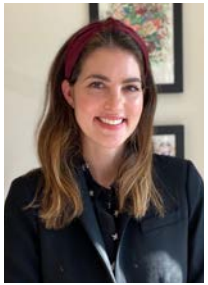
5/25/21

Our Team

Mason Hudon
UW Law (2L)
Introduction; Themes: Fee Structure, Insurance

Dan Ballesteros
UW Law (2L)
Themes: Delivery, Rideshare

Kristen Moran
UW Law (2L)
Themes: Weather; Suggestions



Savannah McKinnon
UW Law (2L)
Themes: Partnerships, Infrastructure and Investment

Lorena Lung
UW Law (MJ)
Database

Dylan Harlow
UW Law (3L)
Database, Platooning

Introduction - Overview

- Introduction
  - Project Overview
- Database Presentation and Outlook
- Platooning
- Rideshare/Delivery
- Themes in the Statewide survey
  - Definitions
  - Fee Structure
  - Insurance
  - Investments/Infrastructure
  - Partnerships
- Suggestions for Washington
- Future CAV Projects
- Questions

Introduction - Three Main Projects

Research Paper

In-depth, structured report on the current state of CAV testing and development throughout the United States.

Focus areas developed in collaboration with Ms. Reema Griffith.

WSTC Report

This presentation and associated information.

Database Development

Designed, developed by founding team of students from the UW Allen School of Computer Science and Engineering, and UW GIX Global Innovation Exchange.

Continued update and refresh managed by UW School of Law Technology Law and Public Policy Clinic students.

Introduction - Areas of Research

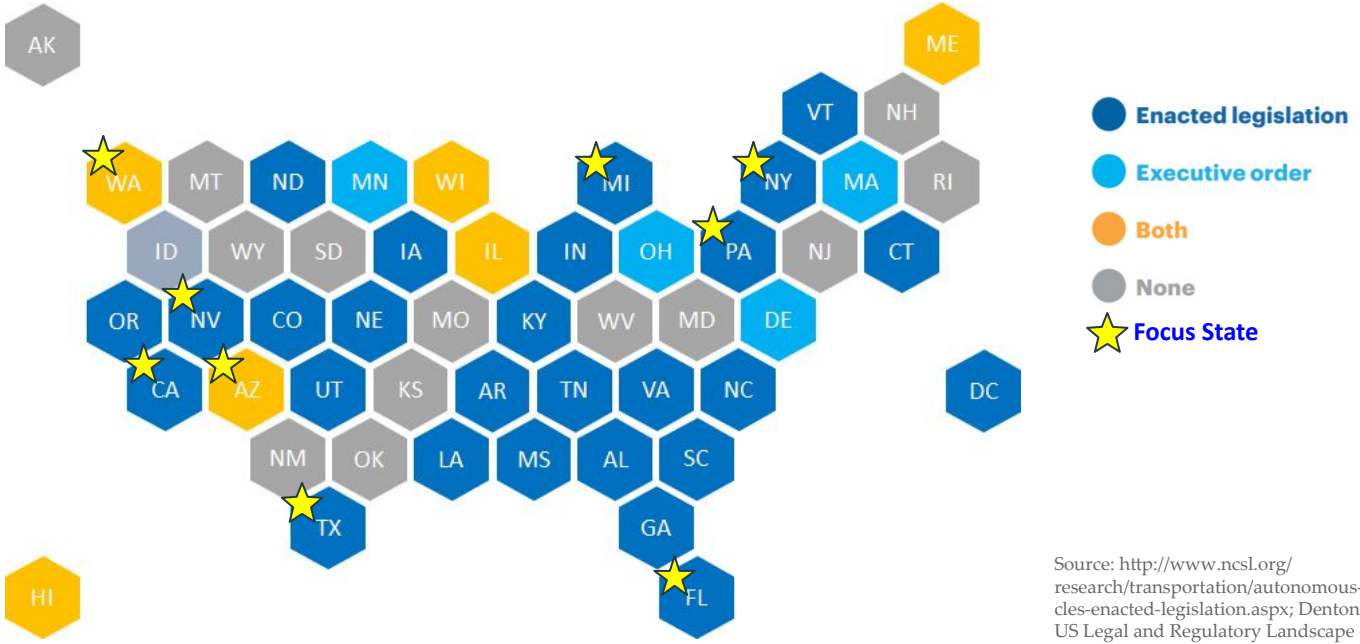
1. Statutory Definitions
2. Commercial-Governmental partnerships
3. Statutory fee structuring for autonomous vehicle testing
4. Statutory fee structuring for insurance for autonomous vehicle testing
5. Platooning development
6. Impact on ride-share and delivery markets
7. Local investment and infrastructure
8. Weather-related concerns associated with autonomous vehicle testing

Introduction - What We Reviewed

- Statutes and Regulations
- Press releases from manufacturers and associated businesses
- Local news reports
- Federal agency rule promulgation notices and comments
- Interviews with relevant (and responsive) state DOTs and DMVs

Introduction - Overview of States

States with AV Enacted Legislation and Executive Orders



Source: http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx; Dentons Autonomous Vehicles US Legal and Regulatory Landscape - SummerFall 2019

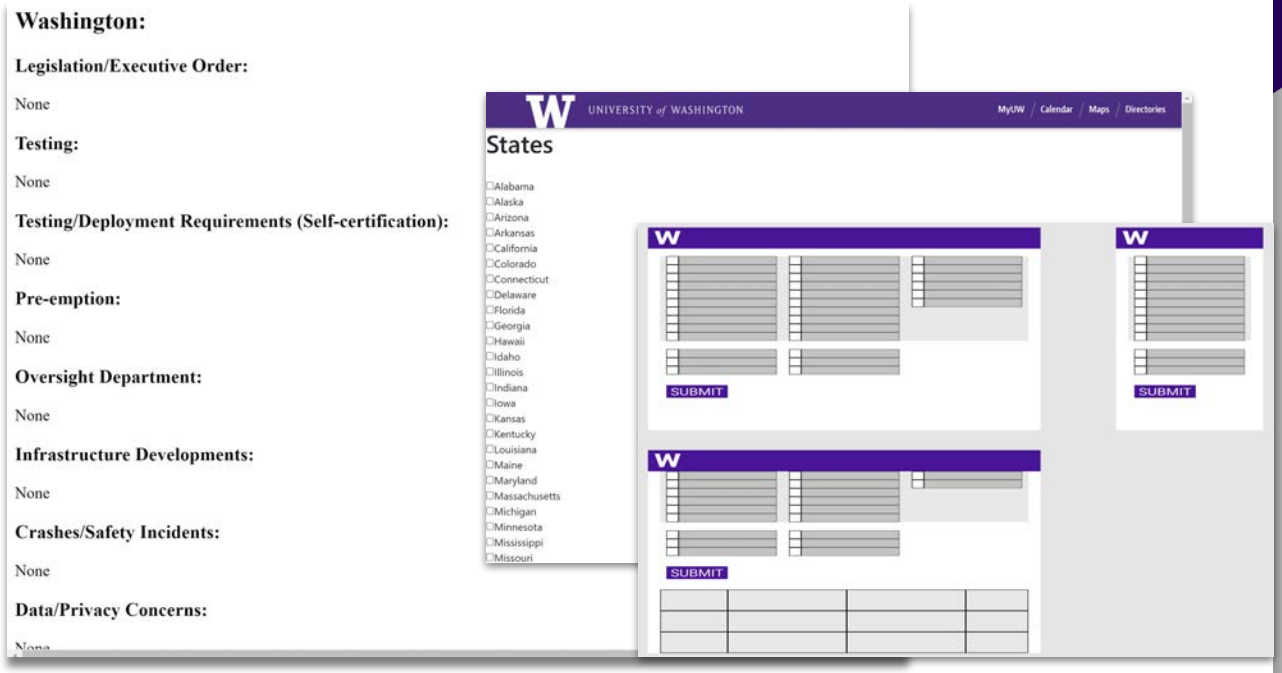
Database

- Public database containing CAV legislation, key contacts, relevant policy and commercial information
  - Select states and categories of filters for side-by-side comparisons of CAV regulations in all 50 states, and D.C..
  - Repository for whitepaper and related links and resources
  - Online archive of collected data
- UW Computer Science & Engineering developers finalizing website hosted through UW.edu domain
- Expected launch Summer 2021

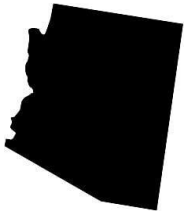
Database

Features

- Alpha Prototype
- Beta Release
- Future Versions
  - Model Sites
  - Mobile Compatibility
  - Updates/Admin
  - Integration



Platooning



Arizona

Allows companies to test commercial platooning vehicles

Platooning, ridesharing networks authorized within state

California PATH partnership conducting testing within the state

California

PATH Partnership between UC Berkeley, Federal Highway Administration, Volvo, and California Department of Transportation entering Phase 2

Phase 1 tests conducted on private and public roads, funding awarded for second phase July 2020

Texas

Texas regulation allows for “connected braking systems” that allow a group of vehicles to share a system for coordinated braking

Lack of regulation within the state has attracted significant commercial platooning tests

Rideshare

Florida

Piggybacking framework

On-demand autonomous vehicle networks are governed by the same laws as transportation network companies.

Voyage operating in the Villages.

Similar state: AZ

Michigan

Moderate framework

For vehicle manufacturers, MIchigan has the SAVE plan. The manufacturer determines binding boundaries. Manufacturers must maintain incident records and provide summaries. Insurance required. For non manufacturers, no straightforward legislation.

Nevada

Extensive framework

Creates laws and regulation separate from TNCs. A permit, fees, and insurance are required. Crashes must be reported. Local governments can require a standard business license, but may not add any other requirements or fees.

Autonomous Delivery Robots

New York

No framework and seen as not allowed

When FedEx used delivery robots in 2019, NYC sent a cease-and-desist letter. There has been no indication that the State feels differently.

Michigan

No framework, but generally permitted

Companies are operating delivery robots as if they are electric bicycles or AVs. No agency has approved this interpretation, but two delivery robot companies are operating and cooperating with local law enforcement.

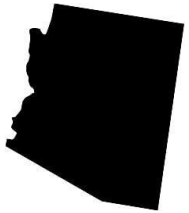
Pennsylvania

Explicit Framework

Delivery robots allowed on sidewalks, paths and roadways and are considered “pedestrians.” PA also regulates speed, size, and load limits. PA requires insurance policies covering $100,000 per incident. Municipalities have sovereign immunity.

States with similar framework: AZ, FL

Themes - Definition of Operator



Arizona

Separate Definitions

Some states, like Arizona, define a human driver and the AV system separately.

California

Reserved Definition

Remote vehicle operator is a licensed driver that is outside the vehicle.

The testing permit without a safety driver must have a Remote Vehicle Operator that has gone through the required training and can communicate with law enforcement and deal with a variety of traffic situations.

Florida

Open-door Definition

Clearly defines the autonomous vehicle system as the AV operator in fully autonomous cars.

AVs that are not fully autonomous require a licensed operator.

Themes - Fee Structure

Pennsylvania

No Fees

Some states, like PA, do not impose fees on AV testing due to technical or preparatory considerations. Other states, like FL and TX do so to attract business and increase local investment.

Other States: TX, FL, MI, NY

Nevada

Moderate Fees

Requires (1) testing certificate and (2) testing license plates

"The fee for the testing certificate is $100 and each testing license plate has a fee of $12."

California

High Fees & Reporting Reqs

Tier 1 (Safety Driver): No Fee

Tier 2 (No Driver): $3,600 Annual for 10 Vehicles & 20 Operators; $50 fee for add

Tier 3 (Deployment): $3,275 Revocable Application Fee

Themes - Insurance

Texas

Minimum Level of Insurance

Standard Vehicle Liability

Every state surveyed with CAV policies requires at least standard vehicle liability insurance to be obtained for each vehicle being operated within state borders. Texas is an excellent example of this.

Florida

Moderate Additional Insurance

Requires (1) an automobile insurance policy with primary liability coverage of at least one million, as well as (2) personal injury and (3) uninsured protection that meets the regular state vehicle requirements

Michigan

High Additional Insurance

For example, Michigan require $5 million of liability coverage submitted to the state DMV.

Nevada allows for a $5 million cash deposit or bond submission.

Themes - Investment and Infrastructure

Texas

Minimum Investment/Infrastructure

Information Gathering Stage

Very little implementation of infrastructure change or CAV investment.

Pennsylvania

Investment/Infrastructure Changes Through Regulation

Pennsylvania sets aside $40 million per year.

Florida

Investment through regulation and partnerships

Four years of $10+ billion funding towards state Department of Transportation. Suntex, Florida Turnpike Enterprise, and city changes based on testing partnerships invest heavily in infrastructure.

Themes - Partnerships

State Partnerships

New York & New Jersey:

- Platooning bus system

Other State Partnerships:

- Michigan partnership with Future-Proofed Corridor with Cavnue

Smart Belt Coalition

Pennsylvania, Michigan, and Ohio formed a coalition to test platooning.

Private Companies

- Aurora & Volvo
- MobileEye & Ford

Themes - Weather Influences

Warm/Dry Climates

California's fair weather aligns with the initial starting point for CAV testing.

Arizona and Nevada with a low chance of rain enticed CAV companies.

Texas weather entices companies to test in its state.

Warm/Wet Climates

Waymo is rain and hurricane testing its cars in Florida

SunTrax and FDOT's facility to test weather conditions

Seasonal Weather

Yeti Snow Technology snow plow testing in Canada and Daimler snow plow testing in Germany

Waymo and Argo testing in winter conditions in America

New York has all four seasons for CAV testing

Suggestions for Washington

Influences on Policy

Weather based testing objectives	Public/private sector partnerships	Coalition with neighboring states
Watch current testing abilities Watch regulation in other states with similar weather patterns	Involve tech companies in the regulation conversation Partner with local organizations, colleges, or other entities Continue CAV workgroups	Create coalition with Oregon and Idaho for a uniformed approach Encourages platooning testing

Safety Issues, Federal Policy Direction, and Public Perception

Suggestions for Washington

New Laws

- CAV Safety (NHTSA)
- Create definitions for:
  - Human operator
  - Safety operator
  - Owner vs. operator
  - Autonomous Vehicle
- Insurance
- Fully/partially autonomous safety requirements
- Minimal risk standards
- Manufacturer responsibility
- Registration/licensing/ reporting
- Fee structure
- Preemption law

Existing Laws

- Change following too closely laws (platooning)
- Exempt CAV operators from texting and other distraction while driving laws
- Ensure new policies do not interfere with DUI, other criminal, and all traffic laws

Suggestions for Washington

New Laws

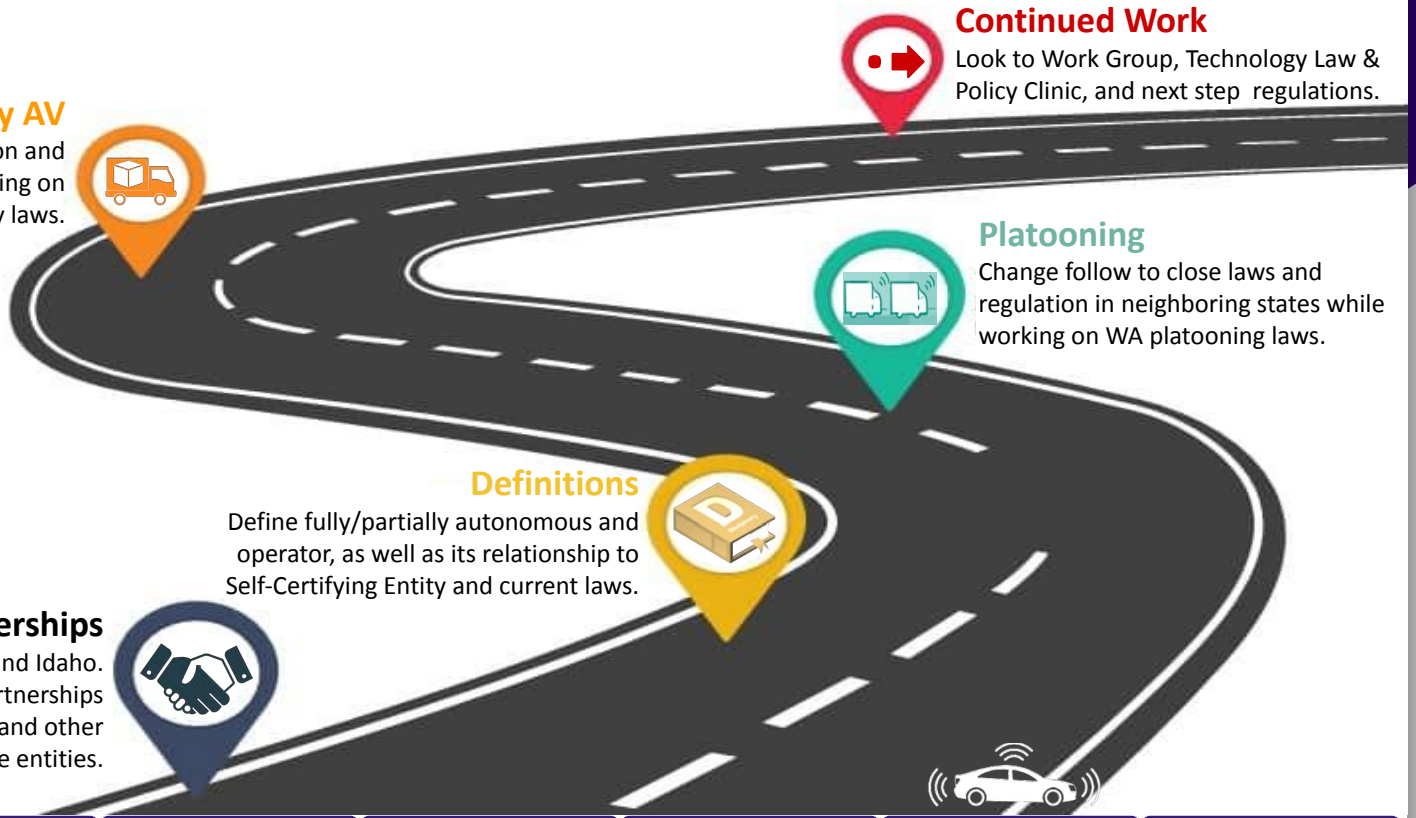
- CAV Safety (NHTSA)
- Create definitions for:
  - Human operator
  - Safety operator
  - Owner vs. operator
  - Autonomous Vehicle (SSB 5460-pilot program)

  EO-1702
  Self-certifying Entity
  (RCW 46.92.010)
- Insurance (RCW 46.30.050)
- Fully/partially autonomous safety requirements
- Minimal risk standards
- Manufacturer responsibility
- Registration/licensing/ reporting (RCW 46.92.010)
- Fee structure (RCW 46.92.010)
- Preemption law to ensure uniformity across state

Existing Laws

- Change RCW 46.61.145, following too closely laws (platooning)
- Exempt CAV operators from texting and other distraction while driving laws (SSB 5460 on screens)
- Ensure new policies do not interfere with DUI, other criminal, and all traffic laws (RCW 46.92.010)

Suggestions for Washington



Continued Work
Look to Work Group, Technology Law & Policy Clinic, and next step regulations.

Delivery AV
Look to other delivery AV regulation and consult local companies while working on WA delivery laws.

Platooning
Change follow to close laws and regulation in neighboring states while working on WA platooning laws.

Definitions
Define fully/partially autonomous and operator, as well as its relationship to Self-Certifying Entity and current laws.

Partnerships
Reach out to Oregon and Idaho. Create other in-state partnerships with schools, companies, and other state entities.

Special Thanks

Jin Terada White

Lead Developer

Kai Daniels

Data Lead

Guanting Li

Software Architect

CAV Online Database Development Team

Special Thanks

WSTC Director Reema Griffith

Dean William Covington

SCHOOL OF LAW

Questions?

AV Freight Mobility Panel

American Trucking Association
PACCAR
Aurora

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission


ATA
AMERICAN
TRUCKING
ASSOCIATIONS

WA AV Work Group Executive Committee Presentation

Ross Froat

Director of Technology & Engineering Policy

American Trucking Associations

Virtual
May 25, 2021

ATA Federation

ATA Federation

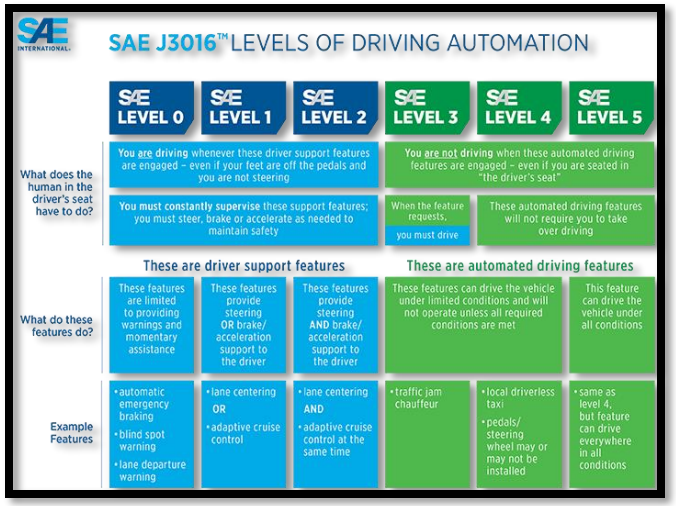
ATA Membership
- Fleets, technology suppliers, truck manufacturers, business solutions providers, affiliated assns.
- 50 state trucking assns.
- Nearly 40,000 members worldwide

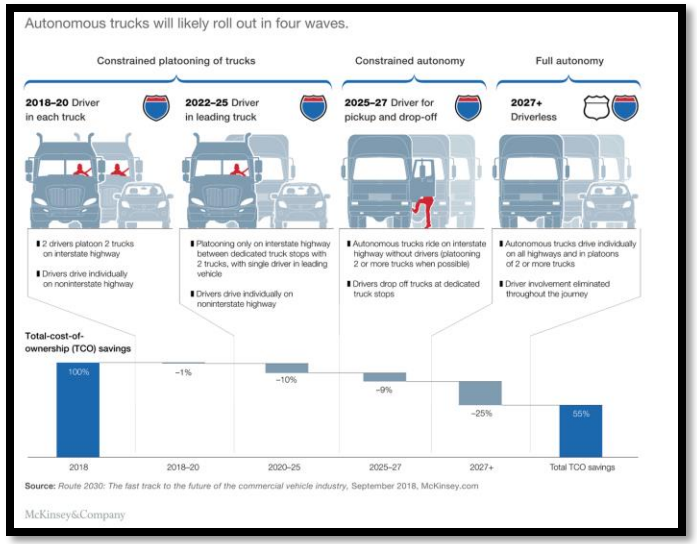
15 Annual Events
- Safety, security, cyber, fleet mgmt./leadership, legal, etc.
- Five conferences
- Six councils
  - Technology & Maintenance Council (TMC)

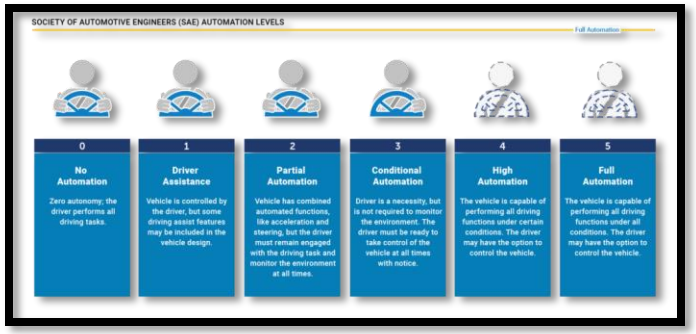
14 Policy Committees
- Environmental & Energy
- Technology & Engineering
- Automated Truck

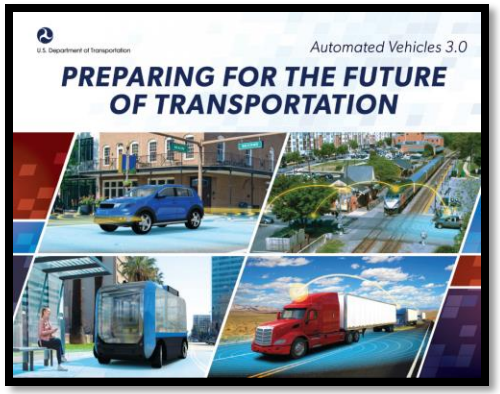
Automated Truck Activities

Intro. to Automated Truck Operations



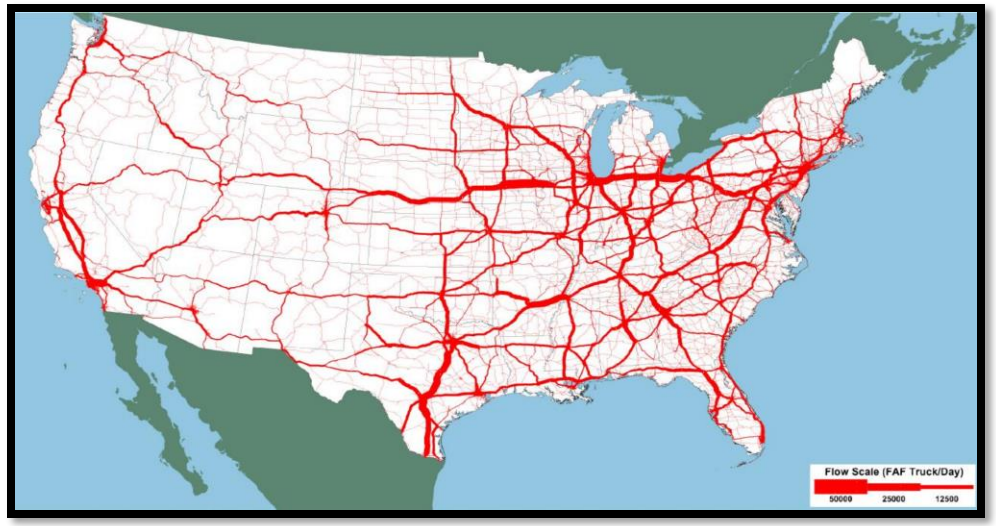


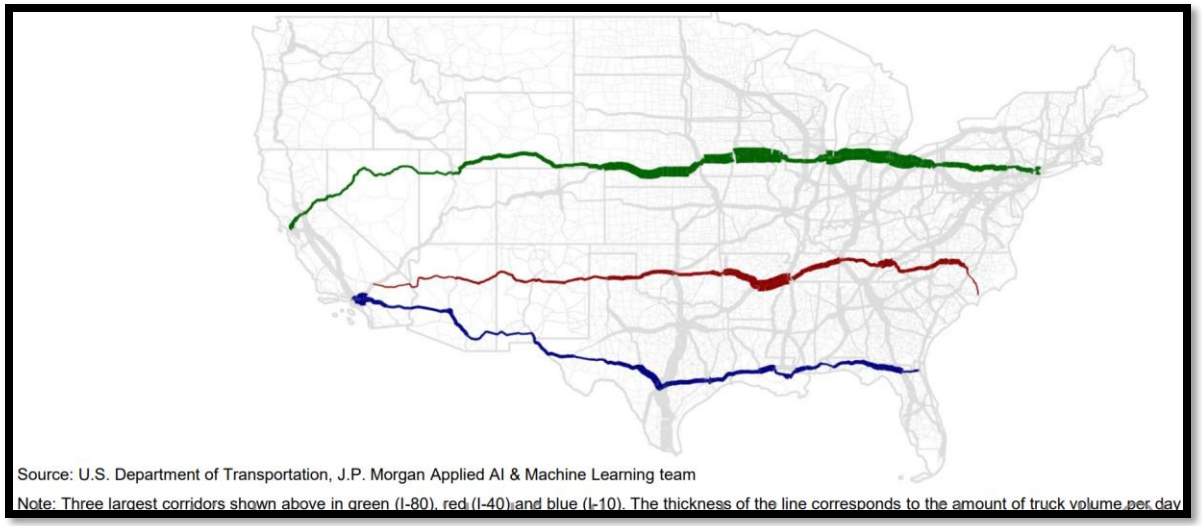




ATA Automated Truck Subcommittee Members

Automated Truck Opportunities





AV L4 trucks could address:

- Truck driver and freight shortage
- Improvements in workforce and society
- Increasing highway safety
- Reducing emissions, increase fuel efficiency
- Increase freight efficiency

Most Recent DOT Automated Trucking Notices and Reports

- NHTSA ANPRM: Framework for Automated Driving System Safety
- DOT AV Comprehensive Plan
- DOT Reports, Trucking Industry Automation Workforce
- FHWA NPA: AV Traffic Controls
- NHTSA ANPRM: ADS Test Procedures

ATA Policy & Advocacy Role

- First DOT AV guidance released Sept. 2016: "*Federal Automated Vehicles Policy*"
- ATA AV policy released Oct. 2017:
  - Safety
  - Flow of interstate commerce
  - Federal preemption and state's rights
  - Uniform state laws
  - Freedom of choice vs. mandates
  - Infrastructure and connectivity
  - Public education
  - Maintainability
- Additional policies have followed: cybersecurity, vehicle-generated data, equipment serviceability

More DOT AV Truck Activities

- FMCSA/VTTI project: Trucking Fleet Concept of Operations (CONOPS) for Managing Mixed Fleets
  - Survey for collecting baseline opinions of ADS-equipped CMVs before and after demonstrations.
  - Demos to be at TMC, NACV, SAE ComVEC, and Automated Vehicle Symposium.
- FMCSA Automated CMV Evaluation (ACE) Program
  - Three Class 8 test tractors at Aberdeen Test Center in Maryland
  - Safely execute test cases on the test track
  - Collect and access test data
- Eight awarded ADS demonstration grants with significant focus on ADS-equipped CMVs.
- FMCSA to host series of sessions for developing industry-based consensus standards for the operation of ADS-equipped CMVs.

ACE
Automated Commercial Motor Vehicle Evaluation

Near-ZEV to Electric/ZEV Truck Activities

ATA & TMC Active Members

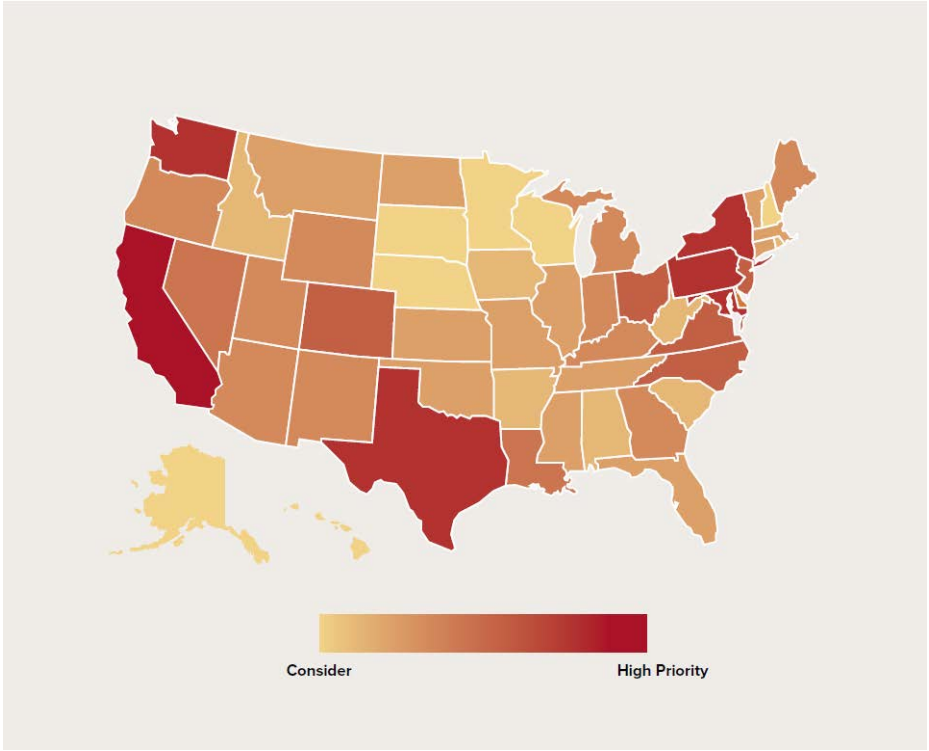
ZEV Adoption by Geographical Market

Key determinants for early roll-out areas:

Technology
- Range (climate, grade, etc.)
- Electricity pricing
- Regenerative braking (benefits from traffic congestion)

Need
- Air quality
- Equity & environmental justice
- Freight flows

Support
- State & city policies / incentives
- Utility programs & rates
- Training programs



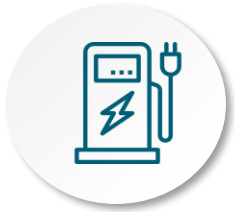
Heat map published by NACFE
Source: High-Potential Regions for Electric Truck Deployments, August 2020

Various challenges still need to be overcome on the road to electric truck deployment.

Route Assessment

Economic Feasibility Analysis

Finances



Charging Infrastructure Deployment

Maintenance & Operations

Fleet Management

End Of Life Services

ATA & TMC Positions

ATA Environmental & Energy Policy Cmte.

ATA Technology & Engineering Policy Cmte.

- Technology neutral
- Fuel neutral
- Motor carrier/business decisions
- Supportive of “green” business priorities and technologies to improve emissions
- Providing more education for increasing fuel efficiency, advancing near-ZEV tech, and setting ZEV goals

TMC Recommended Practices

- S.18 Automated & Electric Truck Study Group
  - Roadmap for Electric Infrastructure
  - Electrified Vehicle Technician Training
- Hydrogen, hybrid, and battery electric light-, medium-, and heavy duty vehicle research/applications
  - Economics / Return on Investment
  - Maintenance Reduction
  - Emissions
  - Public Image
  - Operator and Customer Acceptance
  - Performance

Thank You!

Ross Froat
Director of Technology & Engineering Policy
American Trucking Associations
rfroat@trucking.org

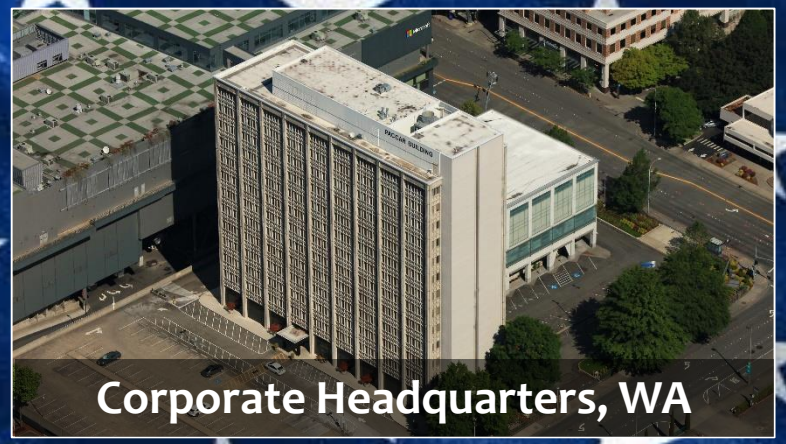
THANK YOU

AMERICAN TRUCKING ASSOCIATIONS


FUTURE
START
PACCAR Inc

PACCAR Inc

Medium Duty 6-16t	Heavy Duty Vocational	Heavy Duty >16t



PACCAR Inc

American Owned

American Made

Importance Of HD Trucks

~12 Million

Trucks In The US*

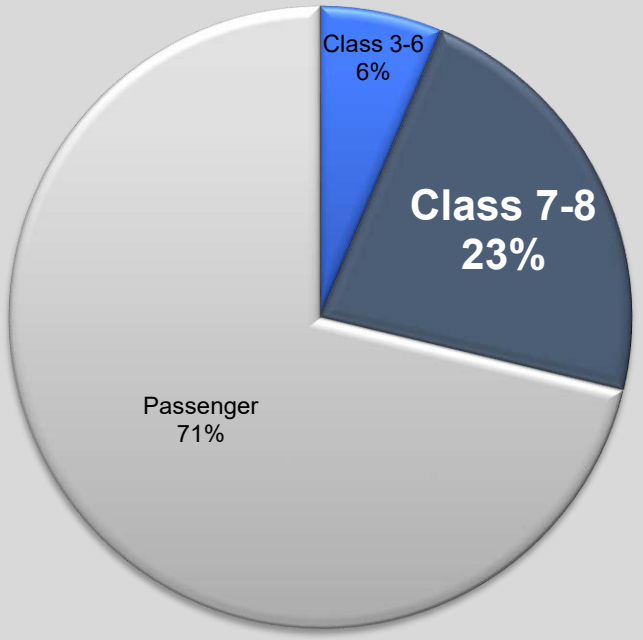
~2/3

Of GDP Worth Of Freight Moved Per Year*

~70%

Of US Freight Moved By Truck*

US Highway Energy Used**



*2019 DOT Freight Facts And Figures

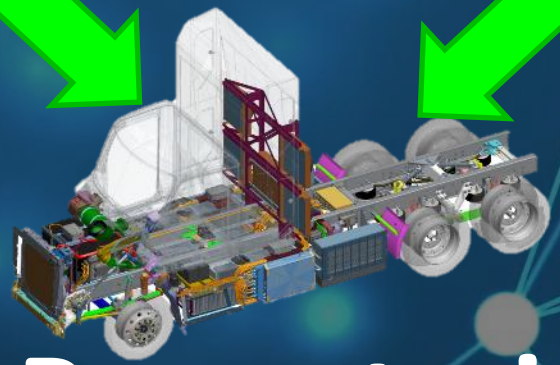
**2020 ORNL Transportation Data Book

Paths To Zero CO_2

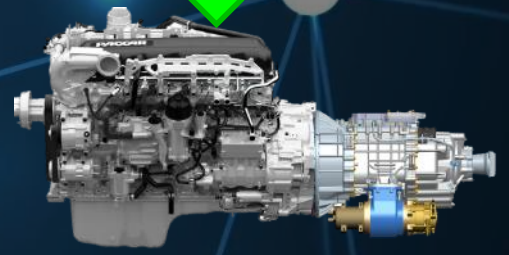
Electricity

Hydrogen Gas

eFuels



E-Powertrain



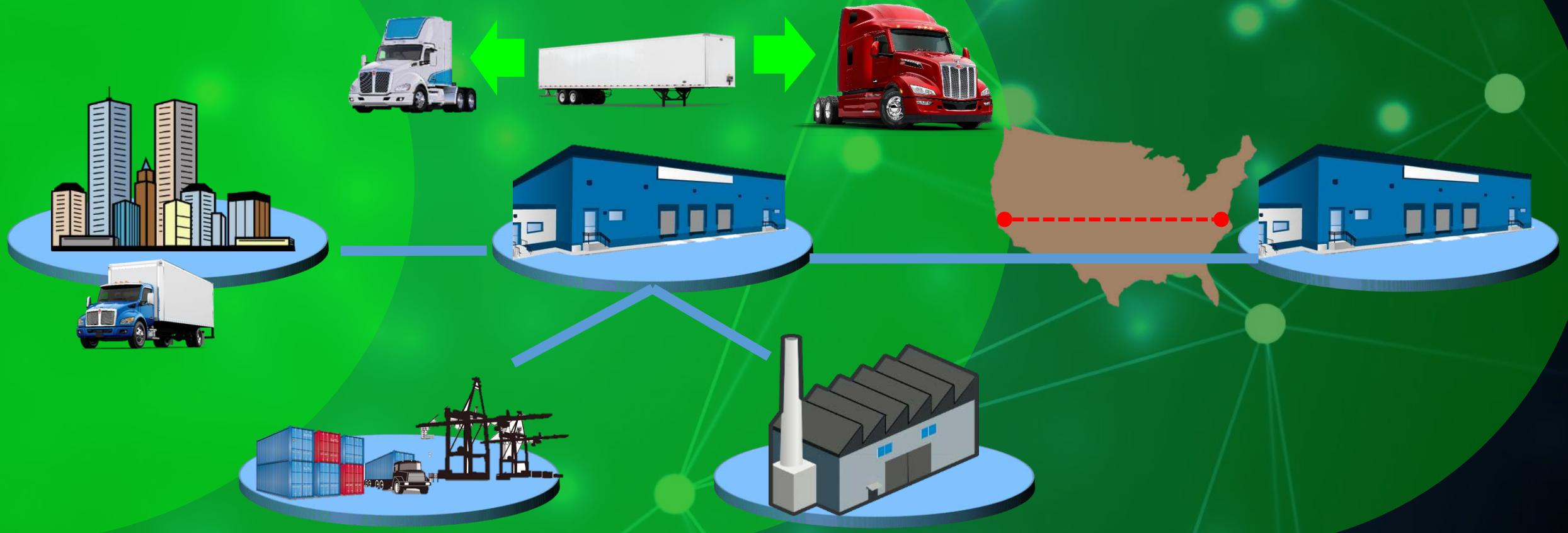
IC Powertrain

Alternative Powertrain In Freight Network

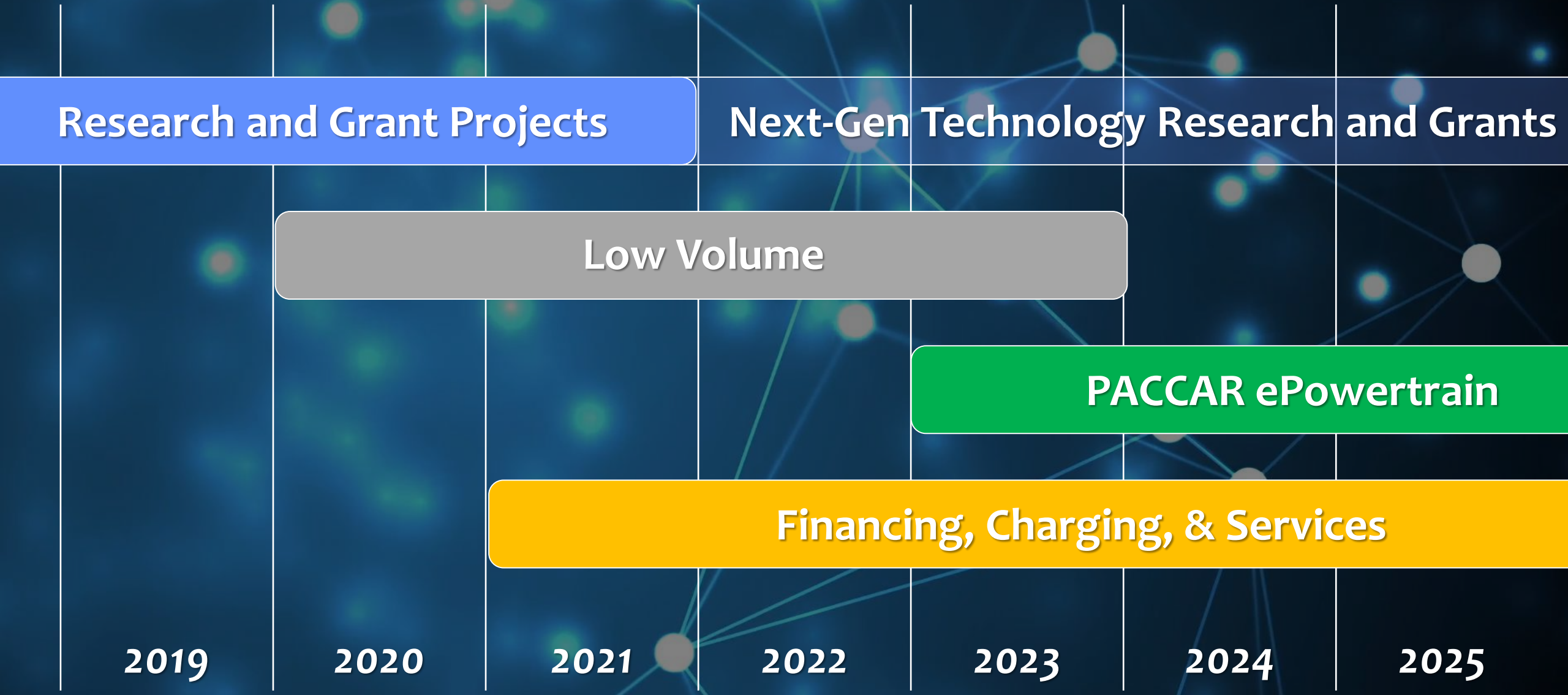
<100 Miles
BEV

100-400 Miles
BEV -> Fuel Cell

400-3000 Miles
Diesel Mild Hybrid
(eFuel/Bio/PtL)



PACCAR Electrification Strategy



Electric Trucks & Infrastructure

PACCAR Inc Peterbilt KENWORTH

Order Now!

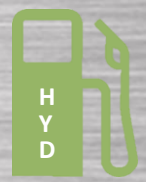
ZANZEFF HYDROGEN FUEL CELL

Zero Emissions "Shore-to-Store"

- **10 - Tractors**

UPS · Southern Counties Express · Toyota Transport · TTSI

- **2 - Fueling Stations**



- $41M CARB Grant
- Complete Product and Infrastructure Focus
- Kenworth - Toyota Partnership Towards Production
- Fueling Stations in Ontario and Wilmington

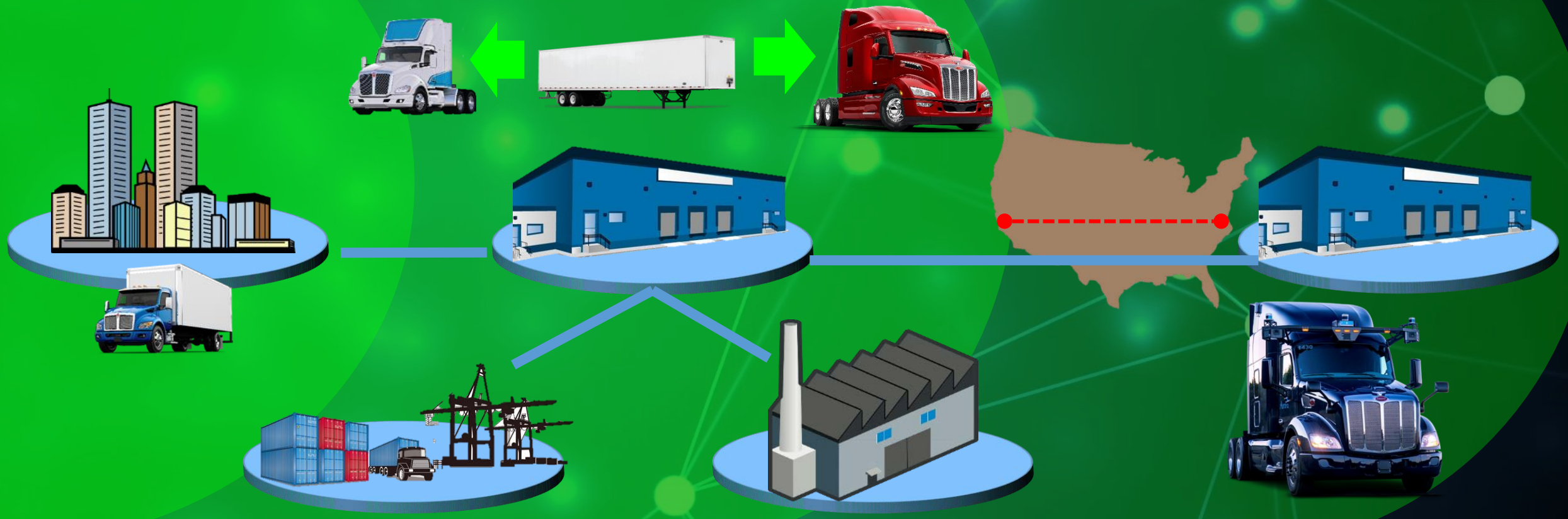
The Port of Hueneme · THE PORT OF LOS ANGELES · Shell · TOYOTA

Alternative Powertrain In Freight Network

<100 Miles
BEV

100-400 Miles
BEV -> Fuel Cell

400-3000 Miles
Diesel Mild Hybrid
(eFuel/Bio/PtL)



L2 ADAS

L2 ADAS

L2 / L4 Autonomy

Level 4 Autonomy at PACCAR

Level 4 Autonomous Driving - Partnership

PACCAR – Aurora Partnership

- Commercialize Autonomous On-Highway Trucks
- PACCAR: Autonomous Enabled Trucks
- Aurora: Self-Driving Software and Sensors
- Enhance Efficiency and Safety

PACCAR Vehicle + Aurora Driver Integration

PACCAR

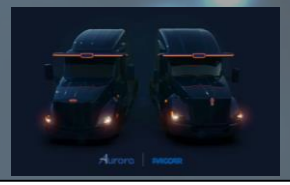
Vehicle Platform

+

Aurora

Aurora Driver

=



Autonomous Truck

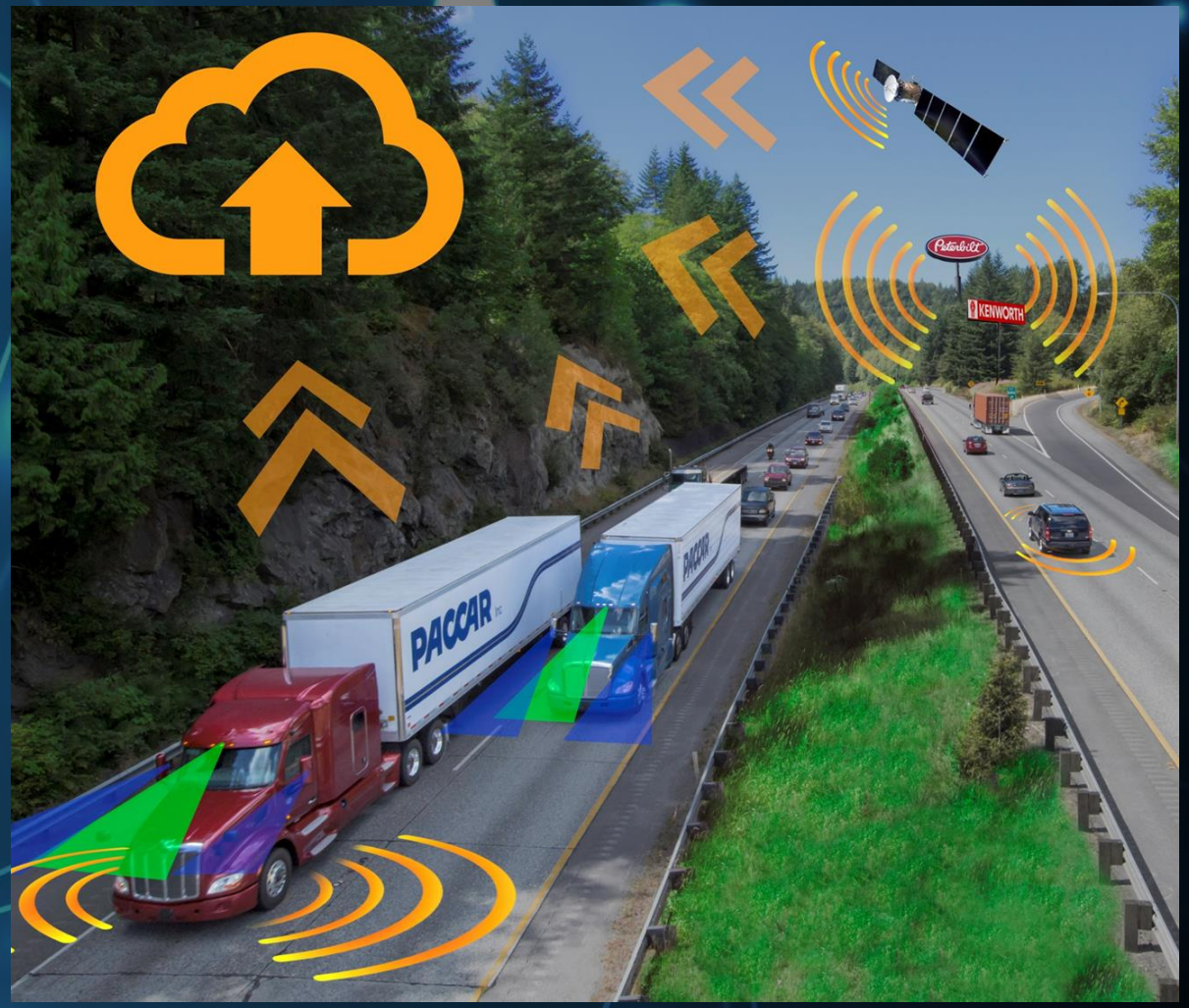
Autonomy Considerations

OBSERVATIONS

- Autonomy is Coming
- New Distribution Models will Emerge
- Increase Fuel and Freight Efficiency
- Autonomy Will Work With Drivers

OPPORTUNITIES

- Washington Leadership
- Remove Barriers to Testing
- Develop the Technical Workforce
- Promote Efficiency and Safety Benefits




Aurora

Our mission is to deliver the benefits of self-driving technology

safely, quickly, and broadly

Delivering the benefits

Increase safety

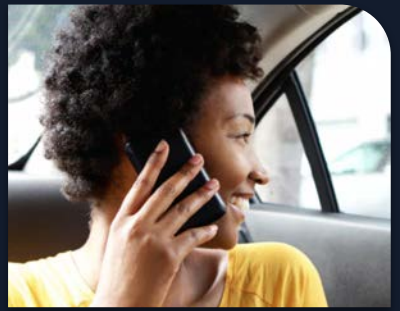
Every hour **154 people lose their lives** on the world's roads

Transform logistics

In the U.S., **trucking accounts for 300B miles annually & 72.5% of total goods** movement

Expand access

25.5 million individuals with a disability in the U.S. have difficulty traveling outside of the home



Improve lives

The average driver spends **54 minutes each work day commuting**—the equivalent of 10 days a year

Our team

We bring together people with extraordinary talent and experience united by the strength of our values.

Strength of our values

Focus

Be reasonable

No jerks

Set outrageous goals

Operate with integrity

Win together

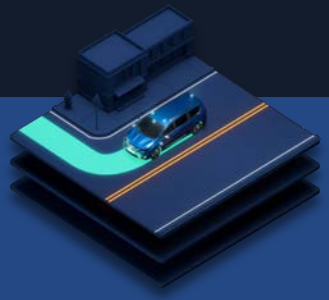
Strength in numbers

1600+
Employees

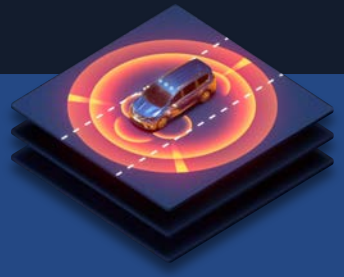
1400+
Product & Engineering


Aurora’s Defining Technology

The Aurora Driver



Self-driving software



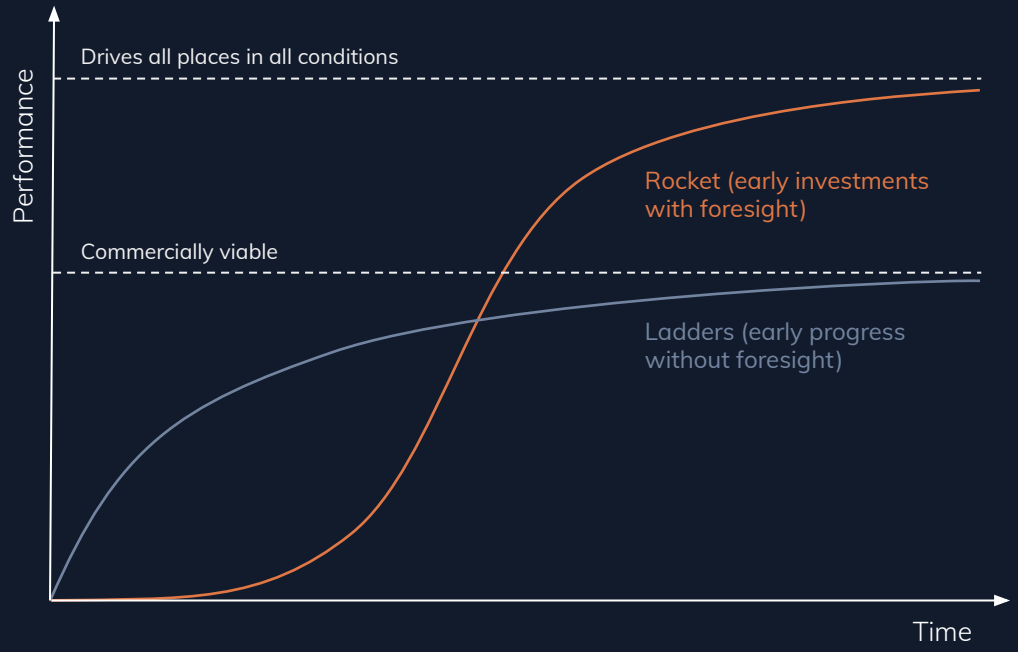
Self-driving hardware

Data services & platform

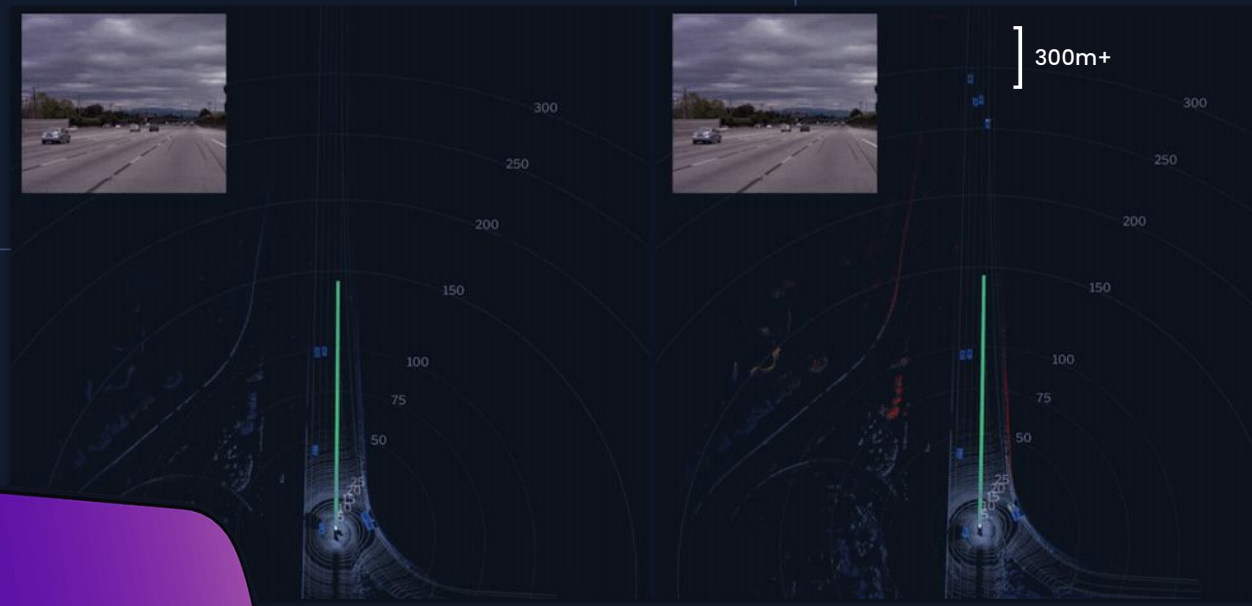
A fully integrated self-driving stack that operates across multiple vehicle types

A smarter approach to development

- FirstLight Lidar
- Sensor simulation
- Aurora Atlas

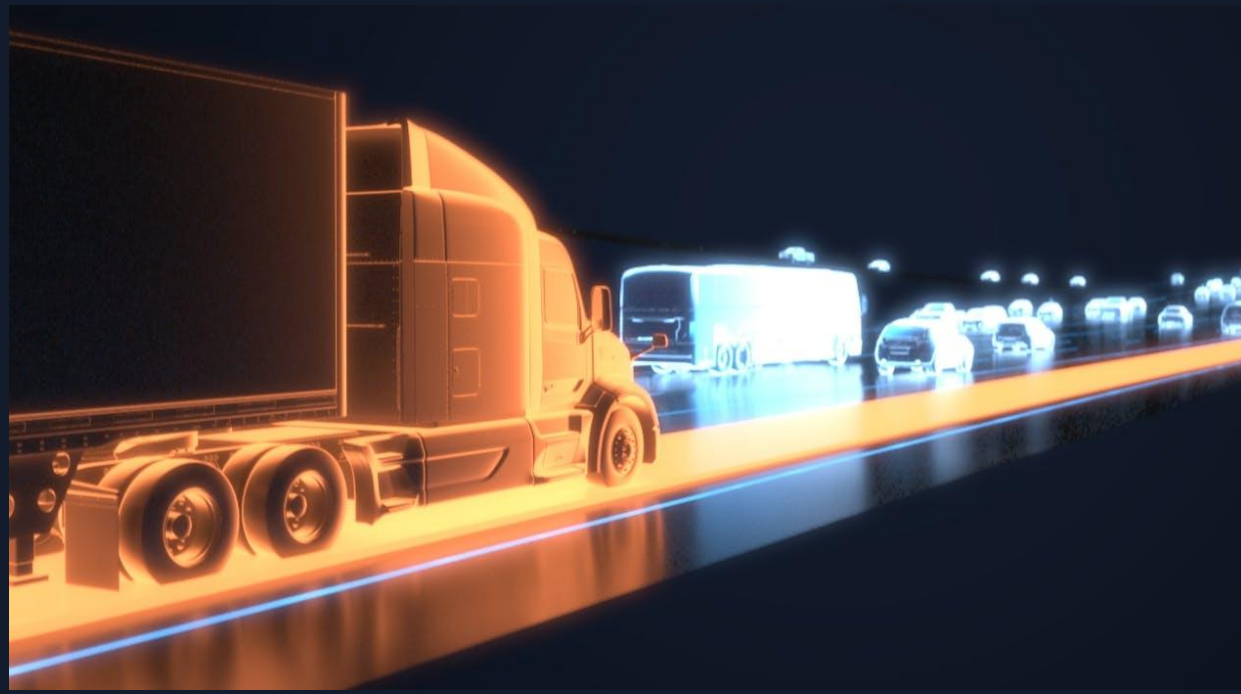


The power of FirstLight Lidar



Sensor Simulation

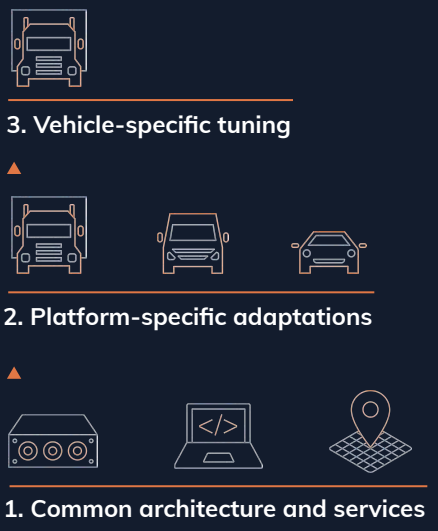
Unlocks rapid
and cost-effective
development



Designed to operate diverse vehicles

The Aurora Driver is designed to operate a wide range of vehicle makes, models, and classes.

Aurora invested early in a hardware suite that minimizes reliance on the vehicle platform and interfaces over a single umbilical, and software that adapts its control strategy to the unique behaviors, constraints, and dynamics of the vehicle it controls.



Approach to safety

A team with breadth and depth of experience

Taking a holistic approach to safety

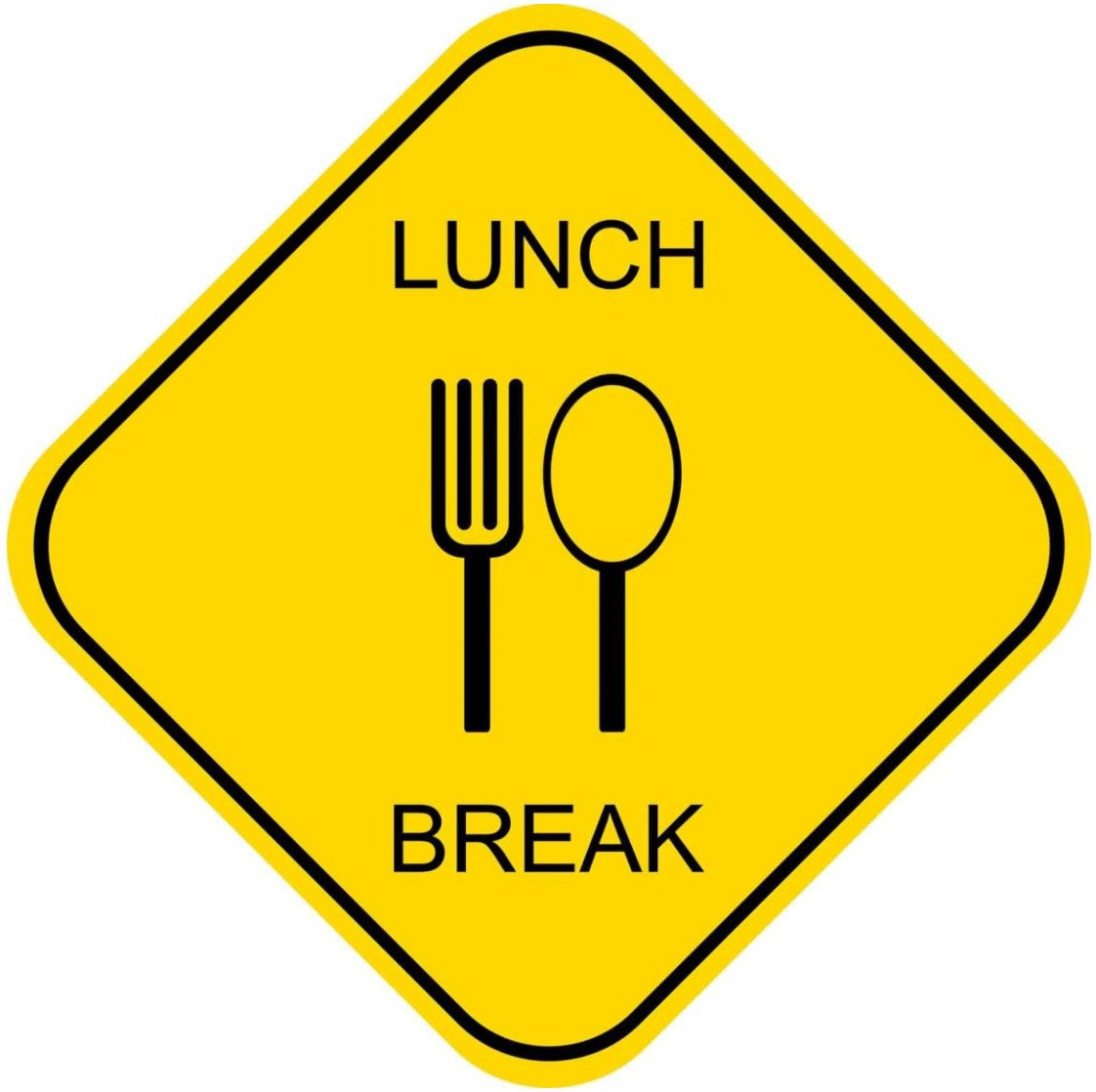
- Safety Management System
- Safety Case Framework

Transparency and collaboration

Commercialization principles

- Sequencing market entry: trucking, passenger mobility, then local goods delivery
- Building an ecosystem of best-in-class partners to scale safely and rapidly
- Focusing on highest-priority use cases
- Remaining capital efficient and asset light by being a “Driver as a Service”


Aurora



Be back at…

12:00 p.m. PT

State of AV Testing

WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

Washington State
Transportation Commission

Intent for today's discussion

- Building on progress to date, an opportunity to reset
- A need to respond to a shift in pace and focus from the industry
  - » Companies have shifted towards road testing in strategic locations to advance the technology in real world environments
  - » Priority has been on locations that push the limits of the technology
- An opportunity to set the direction for subcommittees moving forward

CAV Readiness is a Complex Issue

- No national standards for readiness
- Different starting point for different agencies
- Lack of national vision makes it even harder

Planning & Policy

Outreach/ Public Education

Testing & Early Deployment

Infrastructure

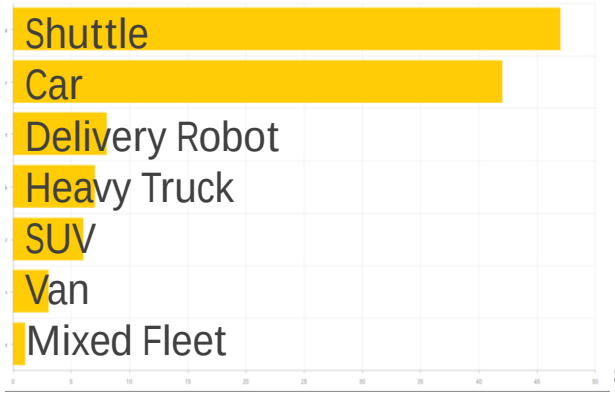
Workforce/ Training

AV Testing – the where, what, when, why, and how

- Types of testing and demonstrations occurring:
  - » Testing at controlled test sites
  - » Demonstrations in dedicated areas or protected corridors
  - » On-road driver testing
  - » On-road driverless testing
  - » Service deployment

Testing Sites by Road Type

Testing sites by Vehicle Type



Key Testing Market: California

- Early investment in GoMentum Station CAV test site
  - » Previously owned by Contra Costa Transportation Authority (CCTA), now owned by AAA
  - » Located on 5,000 acre former naval weapons station
- Permit programs for AV testing
  - » Testing with a driver (since 2014) – 56 permit holders
  - » Driverless Testing (since 2018) - 7 permit holders
  - » Deployment (since 2020) – only Nuro is authorized
- Deployment program that allows for service provision, shared rides, and monetary fares

Driving Factors:

- ✓ Established industry for AV technology development and home to major AV developers
- ✓ Regulations that provide a relatively clear path towards deployment (including the ability to collect fares)
- ✓ Upfront investment on test site location
- ✓ Diverse terrain (both flat and hilly)
- ✓ Mix of development patterns, including dense urban
- ✓ Relatively temperate climate and consistent weather

Key Testing Market: Michigan

- Historic home of legacy automotive industry
- Investment in two major test sites and in on-road connectivity (both State and Federal)
  - » M-City at the University of Michigan
  - » American Center for Mobility
  - » Mound Road
  - » M12
- Permissive testing regulations
  - » Human operator is not required to operate a fully autonomous vehicle
- Ecosystem of industry, government and researchers through “Planet M” initiative.
  - » Led by the Michigan Economic Development Corporation
- Ongoing initiative for a CAV corridor
  - » Innovative P3 relationship between MDOT and Cavnue to develop AV-supportive infrastructure

Driving Factors:

- ✓ Legacy automotive industry and existing talent pool
- ✓ Major investments in test sites
- ✓ State initiated projects to advance research and testing of specific use cases in real-world environments
- ✓ Collaborative ecosystem across industry, research, and government
- ✓ Mix of weather conditions, including periods with snow and ice
- ✓ Mix of urban and suburban conditions

Key Testing Market: Arizona

- 2015 Executive Order outlined early process for safe vehicle testing in Arizona, and instructed the state to eliminate all unnecessary regulations and hurdles
- Early focus on unique and robust partnerships across industry, government, and research community
  - » Among the nation's first active data sharing programs for transportation (AzTech)
  - » Among the earliest CV test beds in the nation (Anthem)
  - » Test facility established by Institute for Automated Mobility (IAM), established in 2018 and overseen by the Arizona Commerce Authority.
- First state to allow for operation of a commercial self-driving taxi service
  - » Waymo self-driving services (with and without a back-up operator)
  - » Regulations permit charging of fares for services

Driving Factors:

- ✓ Permissive regulations implemented early on intended to clear barriers and hurdles for testing
- ✓ Regulations that provide a relatively clear path towards deployment (including the ability to collect fares)
- ✓ Ecosystem of industry, government, and research partnerships
- ✓ Growing local tech sector
- ✓ Relatively simple and consistent suburban form
- ✓ Consistently clear weather year-round

Key Testing Market: Ohio

- Significant investments by public and private sectors
  - » Investment driven by significant Federal grants ($40M Smart Cities and ATCMTD)
  - » Over $500 million by public and private sectors towards development and testing of CAV technologies
- Investment in test sites and roadways
  - » Four roads, covering 164 miles prepared by the State for CAV testing
  - » $45 million SMARTCenter test site at the Transportation Research Center provides 540 acres of various environments for testing
- Environment for public and private collaboration through DriveOhio
  - » State led initiative to bring public and private organizations together to overcome barriers and advance development
- Influence from legacy automotive industry and research community
  - » Honda and Ohio State University serve as key drivers for testing

Driving Factors:

- ✓ Strategic collaborations with Michigan and Pennsylvania
- ✓ Major investment by the State and other partners towards creating a variety of test environments
- ✓ Legacy auto industry leaders
- ✓ Mix of weather conditions, including periods with snow and ice
- ✓ Mix of urban, suburban and rural conditions

Key Testing Market: Florida

- Significant public investments towards transportation
  - » Major investment in SunTrax vehicle testing facility
  - » Major investment in SunTrax vehicle testing facility
  - » Significant Federal grant for Tampa CAV pilot program
  - » Investment in AV shuttle pilots from multiple transit agencies
- Permissive testing regulations
  - » Human operator is not required to operate a fully autonomous vehicle
  - » On-demand AVs allowed to operate under laws that govern TNCs
  - » Uniformity of laws at state level prevent local governments from imposing additional taxes and or fees for AVs operating as for-hire vehicles
- Autonomous Florida Program led by the Florida Chamber of Commerce
- Tech openness associated with tourism
  - » Opportunity for global showcase as key tourist destination
  - » Willing environment of tech-friendly enablers and participants

Driving Factors:

- ✓ Permissive and sweeping regulations
- ✓ Economic development program focused on automation
- ✓ Tech-friendly tourism sector
- ✓ Major investment in test site
- ✓ Rapid growth and construction of sprawling developments requiring mobility solutions
- ✓ Large aging population with specific mobility needs
- ✓ Warm-weather environment for year-round testing

Driving Factors for Key Test Markets

	Established Industry and Talent Pool	Clear and Permissive Testing Regulations	Major Government Investment in Creating Test Environment	Favorable and/or Test-worthy Weather Conditions	Favorable and/or Test-Worthy Geography/ Urban Form
California	○	○	○	○	○
Michigan	○	○	○	○	○
Arizona		○	○	○	○
Ohio		○	○	○	○
Florida		○	○	○	○

Utah's Autonomous Shuttle Pilot Project

Blaine D Leonard, P.E., F.ASCE
Transportation Technology Engineer
Utah Department of Transportation

AV Shuttle Pilot Goals

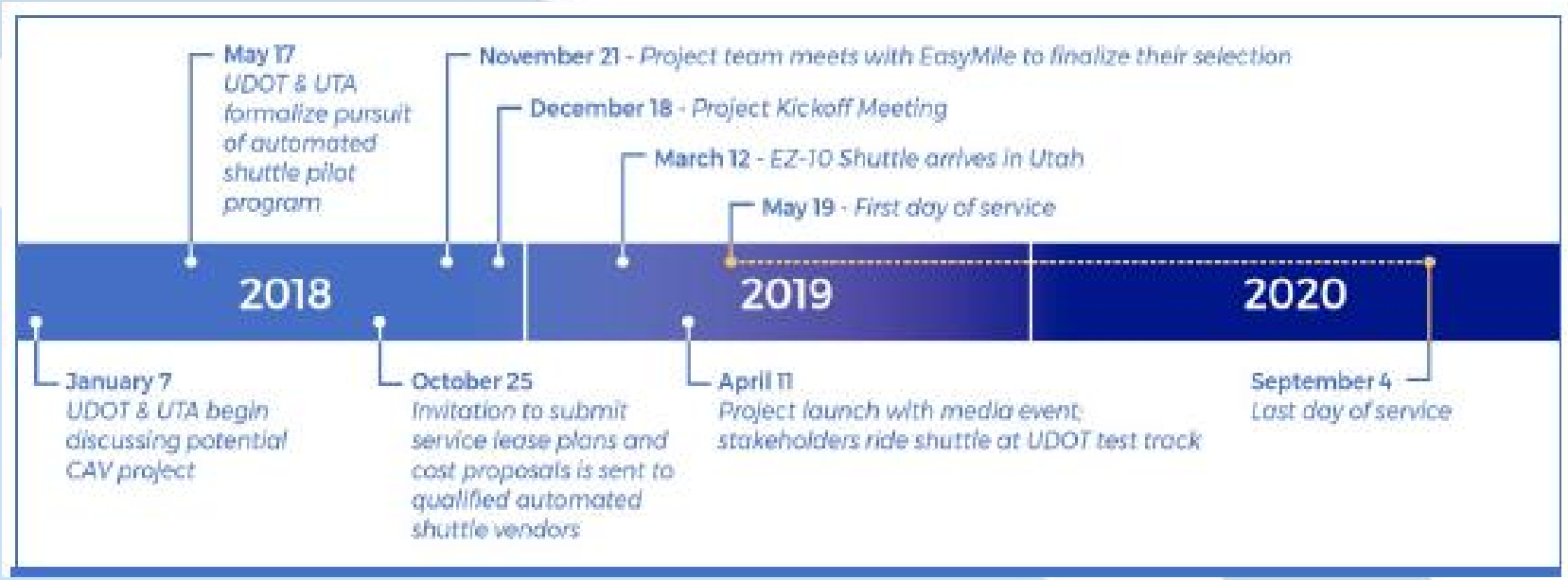
- Expose the Public to AV Technology
  - Dialogue with public / education
  - Assess public opinions and attitudes
  - Exposure for policy influencers
- Evaluate Operational Characteristics
  - Understand capabilities & limitations
  - Viability as first-mile/last-mile solution
  - Inform future permanent transit operations
- Understand Factors that Influence Passenger / Pedestrian Trust
- Test Capability to Communicate with Traffic Signal Infrastructure

Project Overview

- Vehicle
  - EasyMile Gen2
  - Low speed, electric, level 4 automation
  - Capacity for 12 (6 seated / 6 standing)
  - Leased for 15 months with an operator
- Staff
  - EasyMile provided a chief operator
  - Paid EasyMile for a second operator
  - Posted “hosts” at shuttle stops much of the time

Project Overview

- Schedule
  - Planning – 10 months
  - Procurement / set-up – 6 months
  - Operations – 17 months (including a service interruption)



Each individual site required about 14 weeks of advance planning / approval / set-up

UDOT Keeping Utah Moving

UTA

Project Costs

Item	Approximate Actual Cost
Shuttle Lease	$400,000
Outreach, Site Planning, Engineering Support	$232,000
Public Trust Research	$197,000
Signage and Miscellaneous Charges	$21,000
Lessons Learned	$25,000
Operations and Logistics	$90,000
Total	**$965,000**

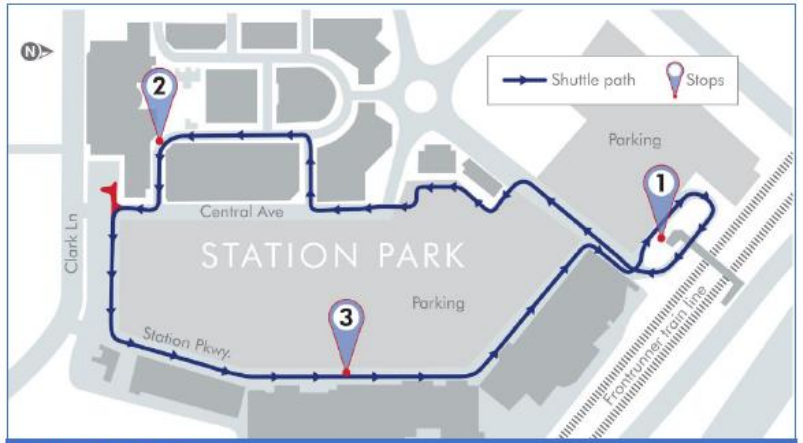


Figure 15: Station Park Route

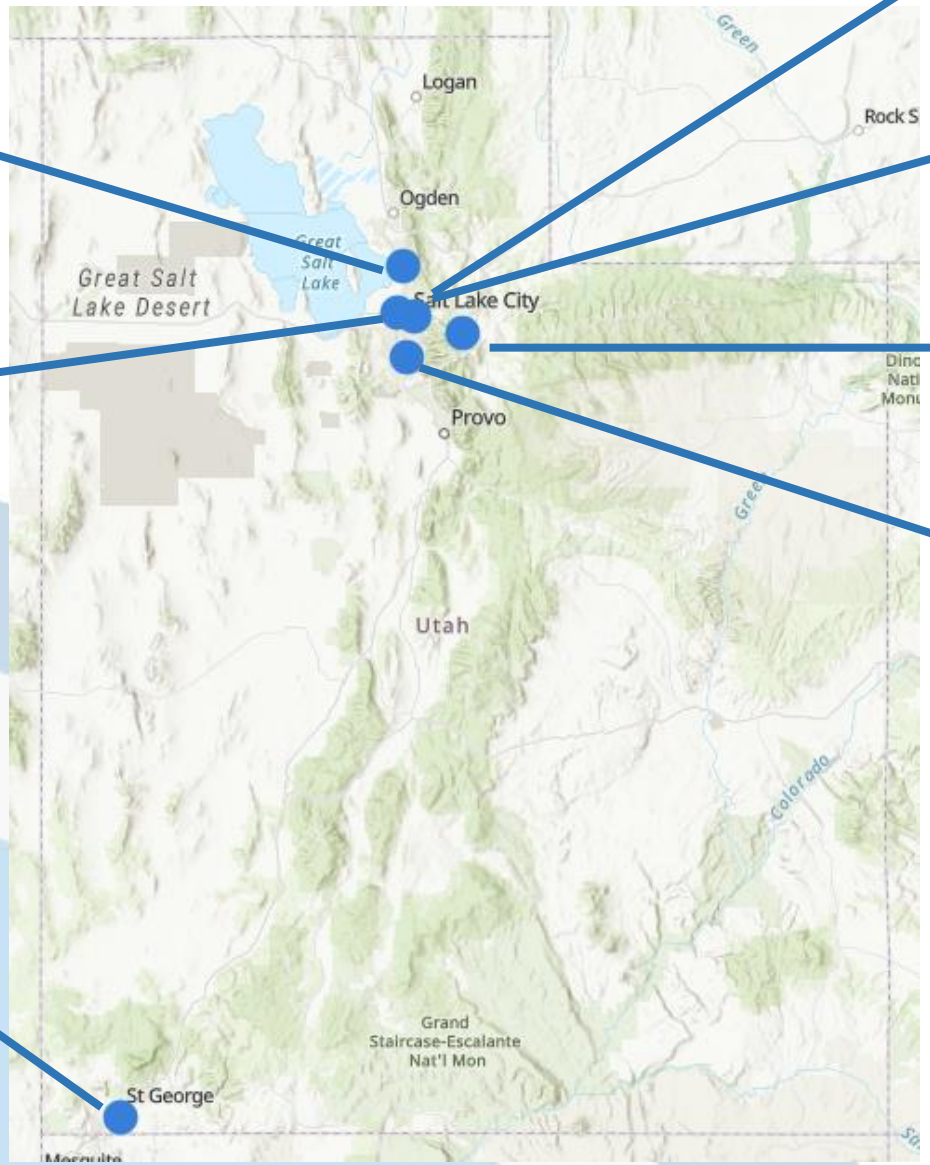
Project Overview - Sites

Station Park

1950 West Office Park

9 Deployments
7 Sites
119 Service Days

Dixie Convention Center



State Capitol

University of Utah

Canyons Resort

Mountain America Expo Center

Safely Transported
6800 Riders

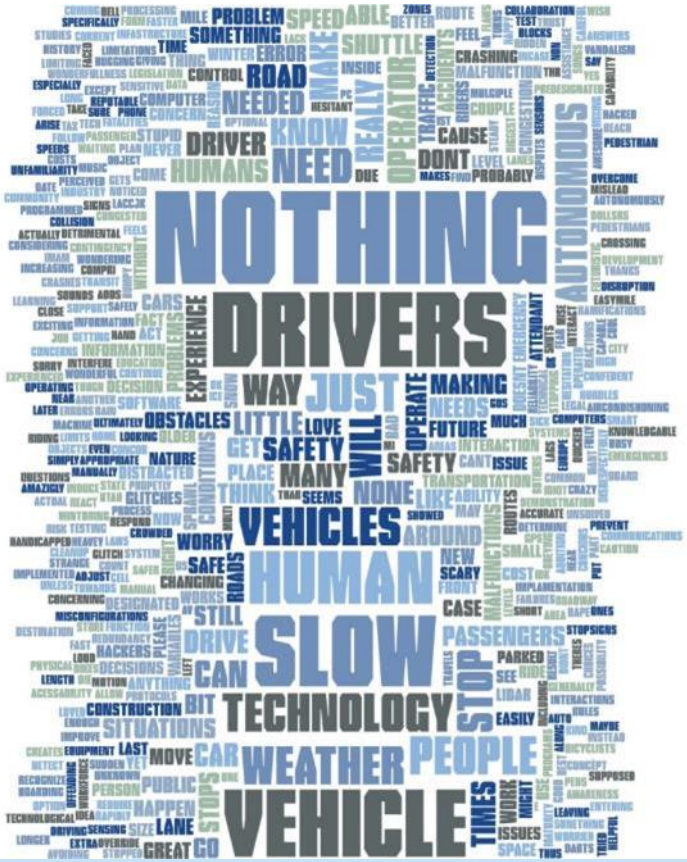
UDOT Keeping Utah Moving

UTA

Project Overview – Public Involvement

- Multiple Sites Provided Broad Interaction
  - State and Local Elected Officials
  - Media
  - Transit Riders
  - Student Groups
  - Disabled Community
  - General Public / Familes

Public Feedback (One of our Key Goals)



"What if anything, makes you hesitant about including autonomous vehicles in transportation?"

- Rider Surveys
  - 822 surveys
  - 92% had never been in an AV
  - 98% felt safe
  - 95% complement transit
  - 95% positive attitude
- Rider Interaction
  - Lots of questions to hosts
  - Selfies
- Media Coverage

Lessons Learned

- Suitability for Transit
  - Complements regular transit system
  - Positive rider feedback – would use this
  - 11-15% of riders connected to transit
  - Electric = competitive cost
  - Generally less cost than regular transit
  - Service quality (up time) still too low (91% vs 95%)
  - Best use is dedicated lane
  - Need effective telematics
    - Communication, monitoring, operations

METRIC	GOAL		AV PILOT
Efficiency & Effectiveness			
Cost per Hour (est.)	$41.97	✓	$22.61
Cost per Mile (est.)	$1.89	✓	$1.79
Cost per Rider (est.)	$5.88	✓	$2.31
Avg. Daily Boardings	100	×	57
Avg. Riders per Hour	10	✓	10
Service Quality			
Service Availability	95.0%	×	91.1%
Autonomous Operation	99.0%	×	98.6%
Safety			
Avoidable Accidents	0	×	1

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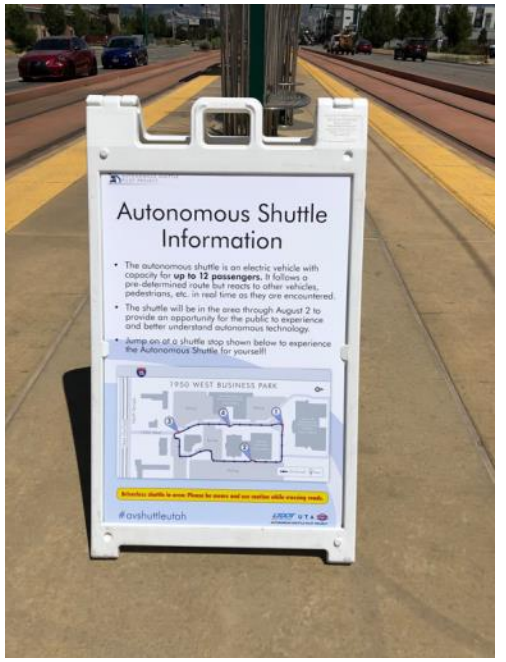
Lessons Learned

- Operational Constraints
  - Inability to move around obstacles
  - LiDAR sensors are over-sensitive (rain, dust, moths)
  - Localization signs needed
  - Battery life marginal in hot/cold weather
  - ADA features not fully compliant
  - Service announcements inadequate
- Regulatory Constraints
  - Approval process is long & cumbersome
  - Not approved for “no-operator” mode yet

Lessons Learned

- Site Constraints
  - Only operates in low-speed areas
  - Route length limited due to low speed
  - Interaction with other vehicles can be problematic
  - Most efficient operations are dedicated lanes
  - Storage / maintenance must be on-site & indoors
- Interaction with Traffic Signals (V2I)
  - Vehicle successfully communicated with signals



Public Trust

- Surveys by Cognitive Psychologists
  - 236 surveys
- Development of Rider Trust
  - Trust is formed with reliable, positive experience
  - Positivity increases with experience
  - Reliability and predictability of automation
- Operator Role
  - Operator has many functions
    - Information, assistance, safety, operations
  - Automation will need to replace all of these roles
  - Important insight for future transit use

Public Trust with No Operator

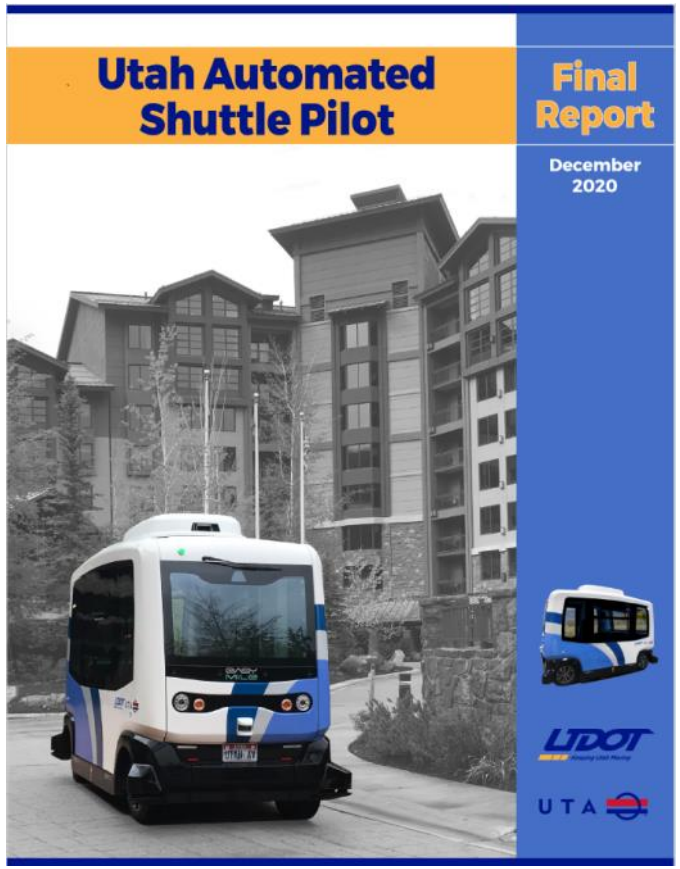
- Interviews / Observations by Cognitive Psychologists
  - 96 recruited riders
  - Half rode with operator / Half rode with “disguised” operator
  - Video-recorded behavior evaluated
    - Interactions / behavior
  - Structured interviews
    - Shuttle operations, comfort, accessibility, information
  - Disguised operator rarely suspected of being an operator

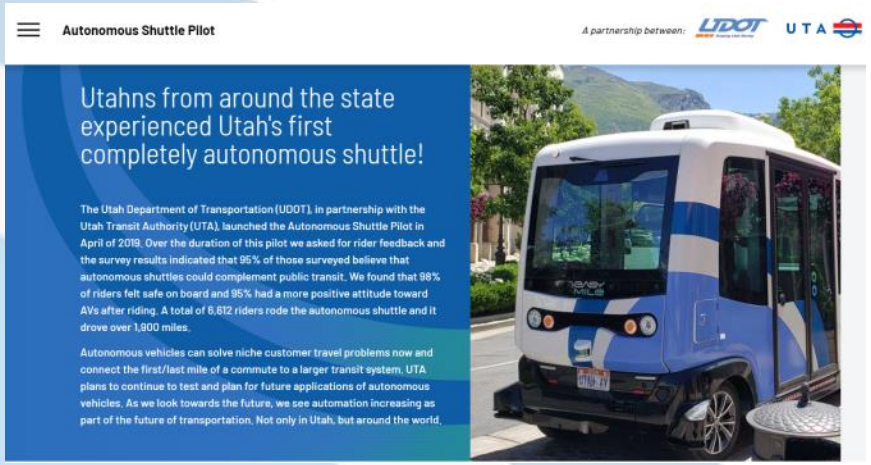
Public Trust with No Operator

- Automation was very effective at meeting rider needs
  - Riders with disguised operator indicated that shuttle operated safely
- Some improvements can be made
  - Additional “welcome” needed as they board
  - Riders felt more comfortable with operator
  - More information on shuttle operations (to riders and pedestrians)
  - Additional capability needed for shuttle to navigate around obstacles
  - Slow speed of shuttle generated negative comments

For More Information

- Final Project Report
  - https://transportationtechnology.utah.gov/
  - Lots of detailed information
  - Includes rider trust studies
- Project Website
  - http://www.avshuttleutah.com/
  - Maps, photos, video





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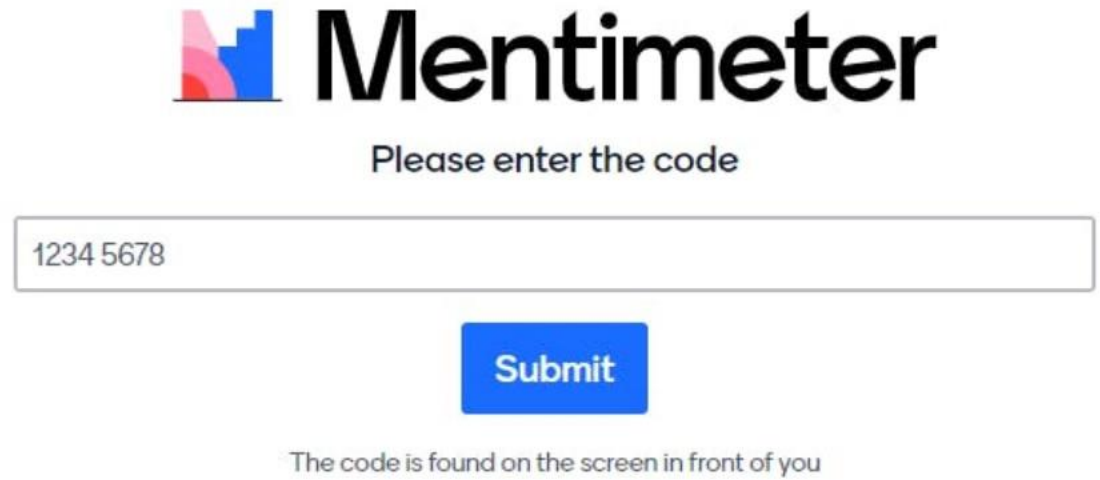
Future Path Update and Discussion

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission

On your phone or laptop

1. Open up a new browser
2. Navigate to www.Menti.com
3. Type in code above: XXXX XXXX



Please enter the name of the agency or company that you represent.

In your view, what should be the principal objective of the Work Group? (rank in order)

Mentimeter

1st — Encourage and attract testing of the technology

2nd — Prepare for near term technology deployment

3rd — Prepare for long term technology deployment

4th — Advance public awareness, communication and understanding of technology

5th — Direct organizational changes needed to prepare for a CAT future

6th — Other

If you selected "Other", what do you think should be the principal objective of the Work Group?

Do you feel Washington State should invest in bringing/ attracting AV testing to the state?

Mentimeter

0
Yes

0
No

When it comes to AV Testing, what do you think should be the primary objective? (rank in order)

Mentimeter

1st Enhance organizational knowledge

2nd Inform policy-making

3rd Support economic development

4th Improve public awareness and exposure

5th Other

6th Testing is not important

If you selected "Other" or "Testing is not Important" please explain.

Specific to preparing for AVs, should the work group focus on early technology (tech already available or emerging), or focus on the long term?

Mentimeter

In advancing Public Awareness and Communication of AV technologies, what should be the primary objective? (rank in order)

Mentimeter

1st	Understand public concerns related to AVs
2nd	Improve understanding of potential traffic and safety implications
3rd	Improve awareness of potential applications of AV technology
4th	Address misconceptions and increasing public acceptance
5th	Share information on State efforts related to AVs

Discussion & Next Steps

Executive Committee Member Items

Open Forum

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission

Closing Remarks

WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

Washington State
Transportation Commission

Closing Remarks

- **Recap Today's Meeting:**
  - » Action Items
  - » Agreements / Decisions

- **Important Dates:**
  - » July 27, 2021 – Executive Committee meeting
  - » October 5, 2021 – Executive Committee meeting

Thank You!

WASHINGTON STATE
AUTONOMOUS VEHICLE
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