Vehicles that are increasingly automated, connected, electric and shared have the potential to profoundly change personal, freight and public transportation.
What should state and local governments do?

• State, regional and local governments use policy levers....
  – to ensure safe and efficient operation of public roadways
  – to foster equity across users of the system
  – to mitigate negative effects of transportation
  – to foster economic development

• For ACES technologies, policy levers could influence private choices toward outcomes that would benefit society
Research Objective

Assess potential policy and planning strategies for use by state and local governments that guide the deployment of AV and CV to create positive outcomes for society.
Effects of AV and CV

• Traffic Crashes
• Congestion
• Pollution
• Land Development
• Mobility for the Underserved
Foundational Research: Social Welfare and Market Economics

• **Externalities:** effects that impact others, yet are not accounted for in market price

• Society benefits if governments implement policy or planning strategies to internalize these externalities in decisions by consumers and producers
## Potential Benefits of Connectivity and Automation

<table>
<thead>
<tr>
<th>Driving Externality</th>
<th>Connectivity (Full V2X)</th>
<th>Autonomy* (L4,5)</th>
<th>Shared Autonomy (L4,5)**</th>
<th>Electrification***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
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<td>Congestion</td>
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<td>Emissions</td>
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<td>Land Use</td>
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<tr>
<td>Mobility</td>
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</tbody>
</table>

- **Strong benefits**
- **Some expected benefits**
- **Weakest benefits/no impact**
- **Uncertain impact**

*Autonomy is defined for this purpose as individually owned vehicle.

**Shared Autonomous Vehicles (SAV) are on-demand self-driving vehicles that operate as part of a privately or publicly managed fleet.

***While not a focus of this NCHRP research, the team provides assumptions of potential benefits of electrification based on known literature.
Importance of Strategic Goals

Decision makers identify....

- **Goals** achieved through AV and CV
- **Performance measures** that support goals
- **Business case** for CV investment
- **Economic development** implications of emerging technologies
Creating Desired Outcomes

**DESIRED OUTCOMES**

- Mitigate safety risks
- Encourage shared AV use
- Address liability issues that may affect market development
- Enhance safety, congestion and air quality benefits by influencing market demand

**Strategic Goals**

**Relevant Policy and Planning Strategies**
Understanding the Strategies Viability Assessments

- Effectiveness and efficiency of strategy
- Political acceptability
- Implementation considerations
- Geographic impact
- Challenges
Safety Strategies

OUTCOME: To mitigate safety risks through testing, training and public education

• Enact legislation to legalize AV testing
• Enact legislation to stimulate CV or AV testing
• Modify driver training standards and curricula
• Increase public awareness
Shared Use Strategies

OUTCOME: To encourage shared AV use (and mitigate increased VMT and vehicle emissions):

• Subsidize SAV use
• Implement transit benefits
• Implement a parking cash-out strategy
• Implement location-efficient mortgages
• Implement land use policies and parking requirements
• Apply road use charging
OUTCOME: To address liability issues that may impact market development:

• Implement a no-fault insurance approach
• Require motorists to carry more insurance
Market Demand Strategies

OUTCOME: To enhance safety, congestion, and air quality benefits by influencing market demand:

• Subsidize CV-equipped vehicles
• Invest in CV infrastructure
• Grant AV- and CV-equipped vehicles privileged access to dedicated lanes
• Grant signal priority to AV- and CV-equipped vehicles
• Grant parking access to AV- and CV-equipped vehicles
• Implement new contractual mechanisms with private service providers
Research Products

Policy Briefing Document

Research Report
Conclusions

• Strategies offer considerations for decision makers based on best information available
  – Technology direction may change
  – Consumers may not adopt certain products

• Public policy making for AV and CV will be informed through a cycle of learning

• Early-adopter agencies will support knowledge creation through support of testing, research and evaluation
Documents available at

– Or search for NCHRP Report 845

For questions, contact

– Ray Derr (rderr@nas.edu) or
– Ginger Goodin (g-goodin@tti.tamu.edu)
ADVANCED DRIVER ASSISTANCE SYSTEMS, CONNECTED VEHICLE AND DRIVING AUTOMATION STANDARDS

Bill Visnic
Editorial Director, Mobility Media

2017 FAV Summit
ACES Policies and Standards Breakout Session
Wednesday, November 15
Our Portfolio

**PUBLICATIONS**
100,000+ collection of technical publications

**CONFERENCES**
30+ technical conferences worldwide

**TECHNICAL STANDARDS**
35,000+ aerospace and ground vehicle standards

**MEDIA**
Magazines, eNewsletters, Tech Briefs

**MEMBERSHIP**
145,000+ members worldwide

**FOUNDATION**
SAE’s charitable arm supporting STEM

**PROFESSIONAL DEVELOPMENT**
Extensive portfolio of courses, webinars
Addressing Industry Transformation Through Standards

Wireless Charging
Driver-Vehicle Interface
Electronics System Reliability
Driving Automation Systems
Active Safety
Functional Safety
Connected Vehicles
Shared Mobility
EV/Hybrid/FC Vehicle & Battery
Vehicle Electronics Cyber Security
Intelligent Transport Systems
Mobility for Persons with Disabilities
SAE Global Ground Vehicle Standards in a Nutshell

- 8,375 Standards Published
- 1,817 Standards Maintained
- 491 WIP Standards
- 9,933 Committee Members
- 609 Technical Committees
- 2,898 Companies
Criteria for Standards Development

- Enhance safety
- Create common language
- Facilitate trade through reduced regulations
- Harmonize global markets
- Improve the environment
- Increase productivity of processes
- Permit common interfaces
- Promote uniform testing or performance
- Reduce costs
Automotive Technology Evolution

**ADAS**
- Lane Departure Warning & Assist
- Parking Assistance
- Adaptive Cruise Control
- Blind Spot Detection

**Connected**
- Signal Phase & Timing
- Real-Time Travel Info
- Safety Alerts & Warnings
- Location Data
- Road Data
- Weather Info

**Automated**
- (AI, Machine Interfaces & Learning, Automation, Cyber)
- (V2X & I2X)
Key Focus Areas for Standards

- **TERMS & DEFINITIONS**: J3016 & J3063
- **SECURITY**: J3061 & J3101
- **SAFETY**: J1626/2 & J3092
- **INTEROPERABILITY**: J2735 & J2953
- **VEHICLE SYSTEM & PERFORMANCE REQUIREMENTS**: J2945/1 & J3155
- **GUIDELINES & RECOMMENDED PRACTICES**: J3018 & J3088
- **TEST & VERIFICATION METHODS**: J3045 & J3029
- **Driver Interface / Human Factors**: J2399 & J2808
ADAS Focus

Standards focus has shifted from Passive Safety to collision mitigation:

- Electronic Stability Control
- Traction Control
- Adaptive Cruise Control
- Forward Collision Warning
- Rear Collision Warning
- Lane Departure Warning
- Crash Imminent Braking
- Blind Spot Detection
- Adaptive Headlight
ADAS Standards

J3063™
Active Safety System Terms & Definitions

J2399™
Adaptive Cruise Control (ACC) Operating Characteristics and User Interface

J2802™
Blind Spot Monitoring System Operating Characteristics & User Interface

J3116™
Active Safety Pedestrian Test Mannequin Recommendation

J3029™
Forward Collision Warning & Mitigation Vehicle Test Procedure – T&B
ADAS Standards

ADAS Related Documents – Work In-Process

- J3088 WIP: Active Safety Systems Sensors
- J3087 WIP: Automatic Emergency Braking Performance Assessment Test Methods
- J3122 WIP: Active Safety Test Target Correlation
- J3157 WIP: Active Safety Bicyclist Test Targets Task Force - New

Safety and Human Factors Standards Related to ADAS

- J3045™: Truck & Bus Lane Departure Warning Systems Test Procedure
- J3048™: Driver-Vehicle Interface Considerations for Lane Keeping Assistance Systems
- J2988™: Guidelines for Speech Input & Audible Output in Driver Vehicle Interface
- J2400™: Human Factors in Forward Collision Warning Systems Operating Characteristics & User Interface
- J2831™: Development of Design & Engineering Recommendations for In-Vehicle Alphanumeric Messages
- J2972™: Definition of Hands-Free Operation of a Person to Person Wireless Communication System or Device
- J2399™: Adaptive Cruise Control Operating Characteristics & User Interface
- J2808™: Road/Lane Departure Warning Systems: Information for the Human Interface
- J3077™: Definitions and Data Sources for the Driver Vehicle Interface (DVI)
Focus Areas for Standards

- Mobile Devices
- Road Side Equipment
- Traffic Information Management
- Systems and Data Back Haul
- Service Providers
- IoT
- DSRC and LTE Communications
- Road Weather
- Curve Warning
- Traveler Information
- Work Zone Warning
- Maps
- Adaptive Signal Control
- Platooning
- Disabled/Vulnerable Road Users

Examples of Driver Alerts

- Forward Collision Warning
- Emergency Electronic Brake Light
- Intersection Movement Assist
- Blind Spot Warning
- Weather Warnings
- Lane Change Warning
- Do Not Pass Warning
- Right Turn in Front
- Signal Phase and Timing
- Curve Speed Warning
- Vulnerable Road Users
If all vehicles were broadcasting the Basic Safety Message (BSM) defined in J2735™ and transmitted according to J2945/1™ an in-vehicle alert could have prevented this car crash.
Safety and Human Factors Standards Related to Connected Vehicles

- **J2395™**: ITS In-Vehicle Message Priority
- **J2831™**: Development of Design & Engineering Recommendations for In-Vehicle Alphanumeric Messages
- **J2988™**: Guidelines for Speech Input & Audible Output in Driver Vehicle Interface
- **J2944™**: Operational Definitions of Driving Performance Measures & Statistics
SAE Cyber Security Standards

✓ Vehicle Cyber Security Systems Engineering Committee
  • **J3061™**: Cybersecurity Recommended Practice for Cyber-Physical Vehicle Systems
✓ Truck and Bus Controls and Communications Network Committee
  • **J1139™**: Serial Control and Communications – Heavy Duty Vehicle Network
✓ Vehicle Electrical Systems Security
  • **J2101 WIP**: Requirements for Hardware Protected Security for Ground Vehicle Applications
  • **J1939™, J1979™, J3005™ & J2534™**: OBD II for Telematics, Vehicle Health Management, Data Access, Vulnerabilities & Cyber Threat Analysis, OTA Updates
Criteria for Standards Development

- Enhance safety
- Create common language
- Facilitate trade through reduced regulations
- Harmonize global markets
- Improve the environment
- Increase productivity of processes
- Permit common interfaces
- Promote uniform testing or performance
- Reduce costs
WEBINAR: Preparing the Energy Grid for Electrified and Autonomous Vehicles

Wednesday, December 13, 2017 at 12:00 Noon U.S. EST

Mercedes-Benz Energy Americas
James Karavakis, Business Development

National Renewable Energy Laboratory (NREL)
Andrew Meintz, Senior Research Engineer

City of Beverly Hills
David Schirmer, Chief Information Officer
Planning for the Future(s)

The FDOT Initiative to Develop Guidance about LRTP Impacts of ACES
AVs, CAVs, ACES: Same cards, different hands

• **Autonomous**  Capable of guiding itself with little or no human input
• **Connected**  Having systems linked to one another and the Web to improve vehicle safety/efficiency and currently require some human input
• **Electric**  Using one or more electric motors for propulsion and
• **Shared-use**  Vehicles used but not necessarily owned by more than one person or organization
ACES are coming ... when?

Based on your knowledge of ACES, when do you think they will have a significant impact on your region? (select the answer that best applies)

Adoption speed affected by:

- Availability
- Cost of features
- Local socio-economic factors
- Ownership and preferences
- Fleet turnover
- Needed infrastructure upgrades
- Liability & other legal issues
- Wildcard issues – social, economic, political, etc.

Source: October 2017 Online Survey of Florida MPOs
The FDOT ACES policy guidance

• Develop planning guidance regarding potential ACES impacts to consider during future LRTP updates.
• Help Florida MPOs/TPOS and local governments account for local ACES impacts in upcoming LRTP updates.
How the guidance is being developed

- Literature Review
- MPO Survey and Interviews
- Scenario Planning
- Travel Demand Model Testing
Key guidance elements

Please rank the following in terms of information or guidance you may need to better assess future transportation technology impacts?

- Goals and Objectives
- Mode Use Impacts
- Project Prioritization
- Project Needs Identification
- Public Engagement
- Socioeconomic Data
- Traffic Operations
- Transportation Revenue
- Travel Demand Modeling

Source: October 2017 Online Survey of Florida MPOs
ACES-driven scenario planning

- Engages more diverse stakeholders
- Illustrates land use/transportation trade-offs
- Expands informed decision-making
- Helps develop performance measures and evaluate different policies’ impacts on targets
- Explores broad array of livability issues
Adapting existing models

Two models adapted based on regional characteristics and model type:

**Gainesville**
- Traditional 4-Step Model with mode choice and transit
- Area includes a mid-size urban area and a major university

**North East Florida Regional Planning Model (NERPM)**
- Activity Base Model
- Large multi-county area with diverse population
Adapting existing models

Socioeconomic Data Considerations

1. Shifts in Population components (i.e. aging population)
   - Older populations
     - less likely to embrace technology
     - more likely to have enhanced mobility

2. Shifts in Land use
   - The “Amazon” effect
   - Shift from Commercial Employment (SIC 50-55) to
     - Industrial Employment (SIC 01-39)
     - Service Employment (SIC 40-49, 60-93)
Adapting existing models

• Shift in average trip lengths
• Use of AVs increases tolerance for longer trips
• More impact on home-based work trips in areas with higher office employment
• Changes in capacity
• Restricted to limited access and high-level arterial facilities
• Limited on arterials by separation of bike/ped facilities.
Adapting existing models

- Changes in out-of-vehicle times (terminal times)
- AVs decrease out-of-vehicle time from vehicle to destination
- More likely in Downtown areas or areas with remote parking
- Changes in transit ridership
- Ride sharing or transportation network companies (e.g. Uber)
- Focus shift to premium transit
Close-up: Electric vehicles
Florida State Transportation Trust Fund
Fiscal Year 2015 - 2016 Receipts in $Millions

- Rental Car Surcharge
- Miscellaneous Revenue
- Reimbursement/Turnpike
- Documentary Stamps

Note: “Other” category includes interest on investments, aviation fuel taxes, reimbursement of expressway authorities, and reimbursement of DOT-owned toll facilities.

Source: Florida Dept. of Transportation
EVs and their impacts

Conditions affecting EV impact:

- Policy
- Incentives
- Declining vehicles cost
- Range and recharging limits
- Charging supply
- Competition from existing or alternative technologies

Average penetration of EV in light duty national vehicle stock:

2020: 1%  
2030: 7%  
2040: 33%

Sources: U.S. Energy Information Administration; OPEC World Outlook; Florida Solar Energy Center, et al.
### ACES Strategies and Tools

**Potential Impacts of an ACES future on Long Range Transportation Goals**

<table>
<thead>
<tr>
<th>Sample LRTP Considerations</th>
<th>Potential Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety &amp; Security</td>
<td>Safety</td>
</tr>
<tr>
<td>Quality Infrastructure</td>
<td>Infrastructure</td>
</tr>
<tr>
<td>Efficient &amp; Reliable Mobility</td>
<td>Land Use</td>
</tr>
<tr>
<td></td>
<td>Capacity</td>
</tr>
</tbody>
</table>

**Potential Impacts**

- Safety
- Infrastructure
- Land Use
- Capacity
- Mode Choice
- Freight
- Revenue
- Parking
## Next steps and deliverables

<table>
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<th>NOVEMBER</th>
<th>DECEMBER</th>
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<tr>
<td>Conference input/feedback</td>
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<tr>
<td>Independent review (MPO National Experts)</td>
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<td>Revisions to manuscript</td>
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<td>First submittal to FDOT</td>
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<tr>
<td>FDOT comments received</td>
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<td>12/8</td>
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<tr>
<td>Comments addressed and final version back to FDOT</td>
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Questions and discussion

Source: Mercedes Benz
(mbusa.com/mercedes/future/model/model-All_New_F015_Luxury)

Source: Buick Avista Concept interior