Planning for the Future(s)

The FDOT Initiative to Develop Guidance about LRTP Impacts of ACES

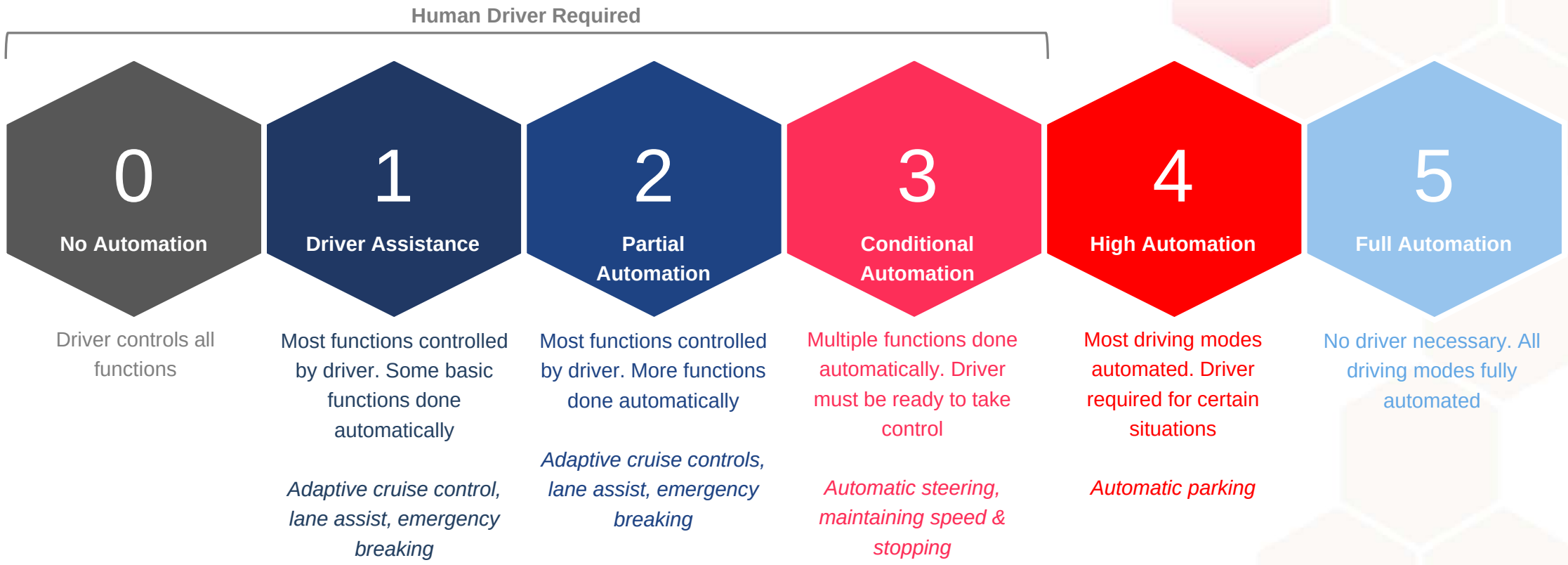
A
Automated - Vehicle capable of guiding itself with little or no human input

C
Connected - Vehicle having systems linked to other devices to improve safety or efficiency

E
Electric - Vehicle using one or more electric motors for propulsion

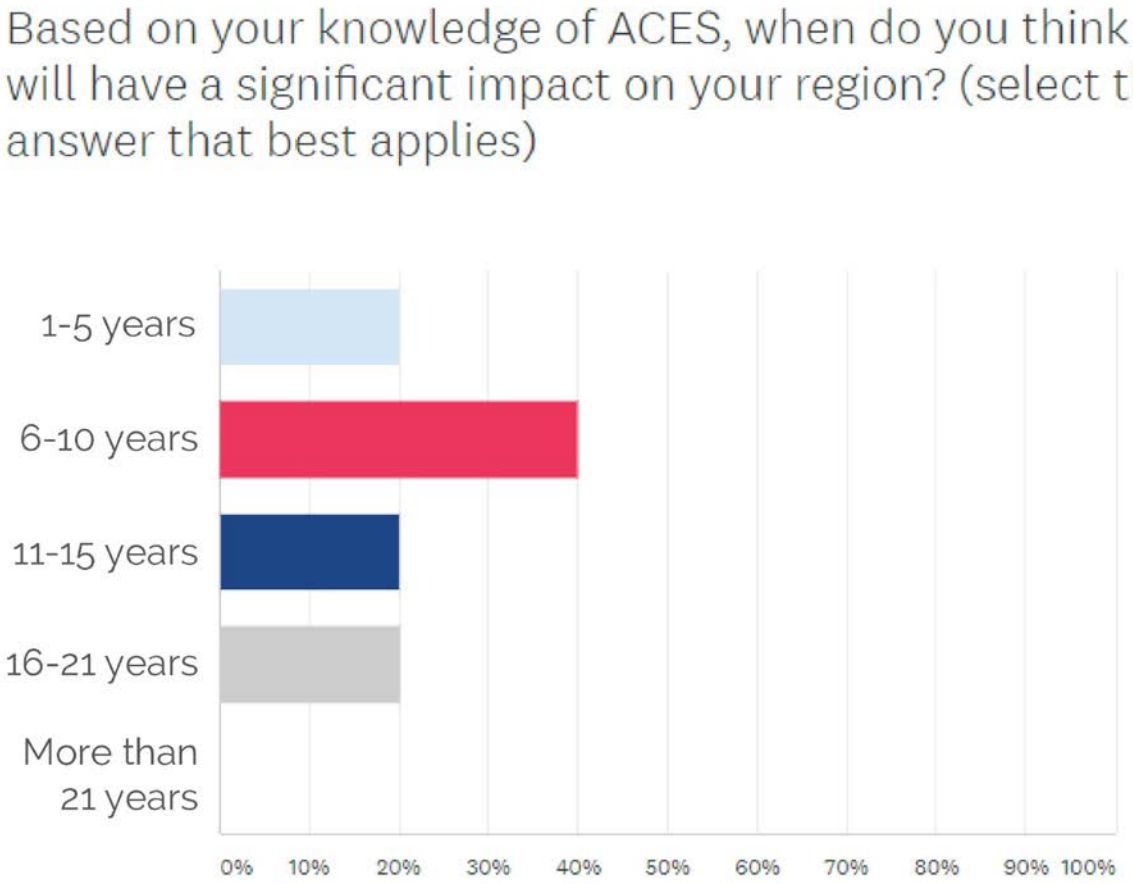
S
Shared-use - Vehicles used (not necessarily owned) by more than one person or organization

Levels of Automation



Source: Society of Automotive Engineers

ACES are coming … when?



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

Florida Activities

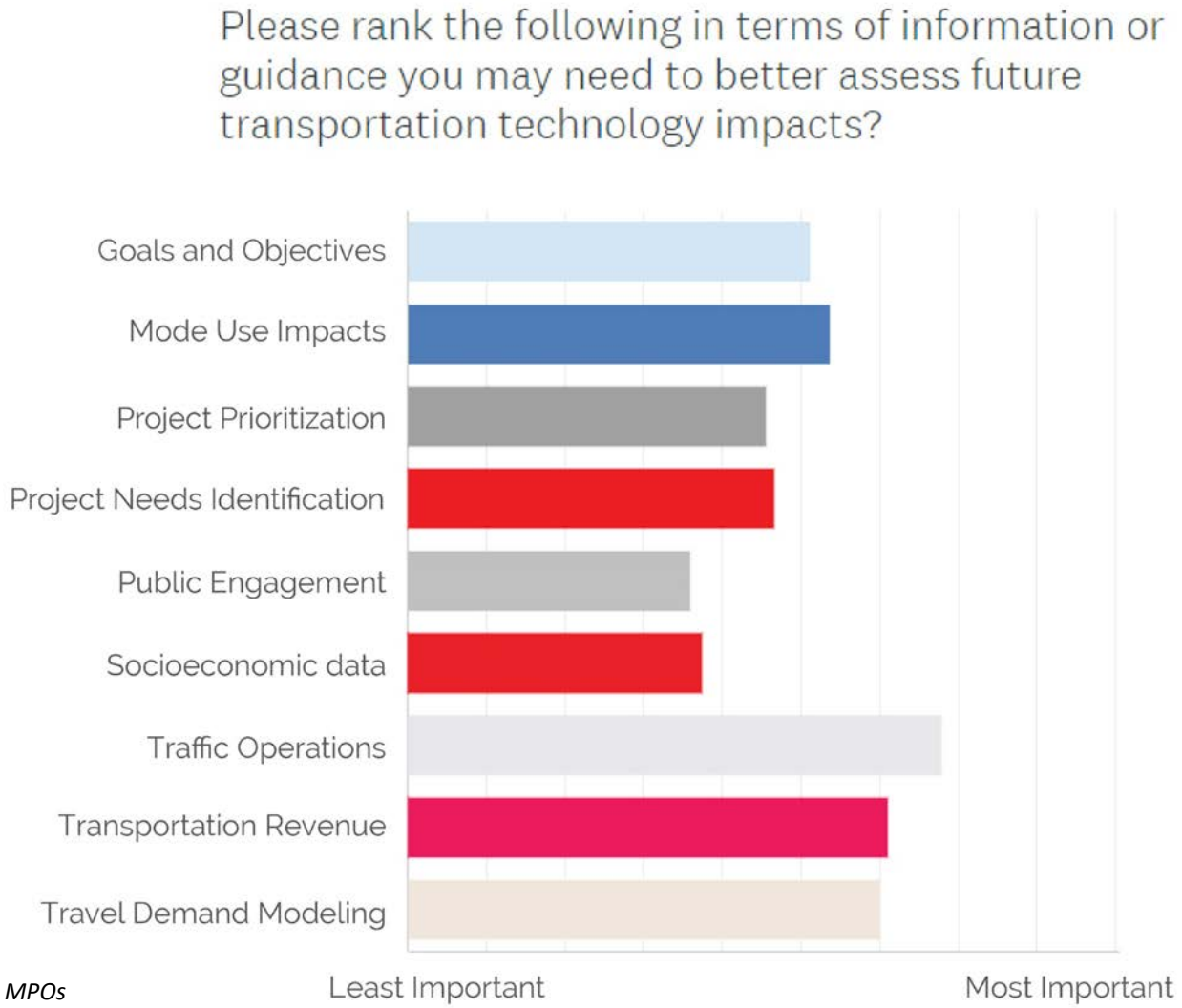
The FDOT ACES policy guidance

- 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

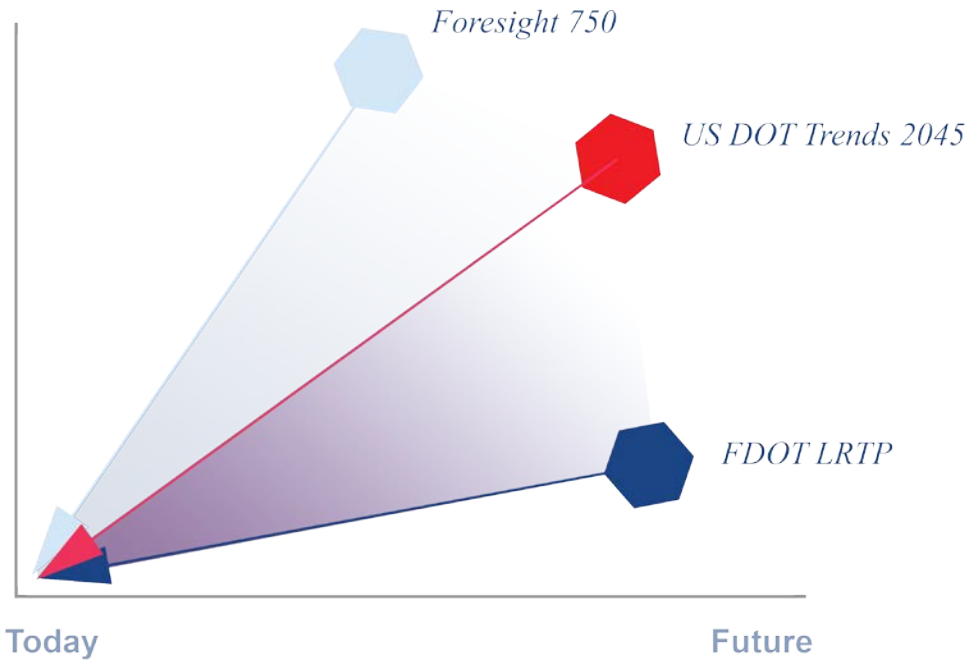
Key guidance elements



Source: October 2017 Online Survey of Florida MPOs

ACES-driven scenario planning

SCENARIO PLANNING:
creating possible futures and assembling options



- 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

FHWA 2035 CV/AV Scenarios

Enhanced Driving Experience

Managed Autonomous Lane Network
AV lane networks

AV travel is considered to a large-scale lane network with significant consumer adoption

Ultimate Driver Assist
Ultra-Connectivity

AV adoption stalls, CV becomes ubiquitous

Slow Roll

Slow Roll
Minimal Plausible Change

Accounts for advances in safety technology, TSMO and mobility services

Driver Becomes Mobility Consumer

Niche Service Growth
High AV/CV in certain cases

Niche applications for CV/AV dominate the landscape

Competing Fleets
Automated TNV fleets compete

Level-4 AV is safe for most trips but are dominated by completing fleets

RoboTransit
Automated mobility-as-service

Strong public-private partnership for system optimization

Trajectories towards CV/AV advancements

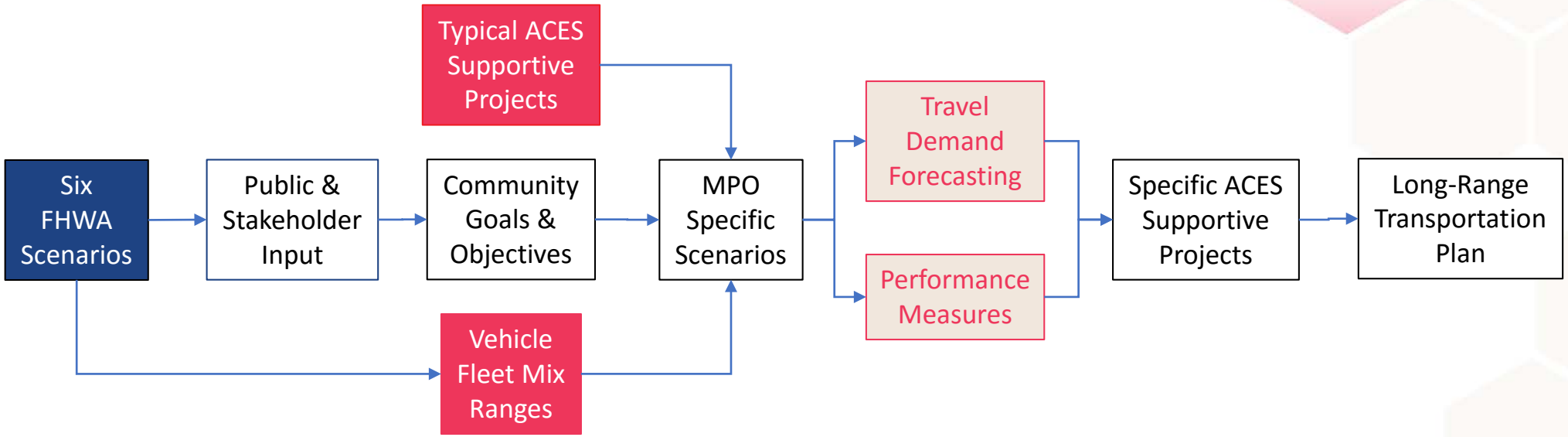
TODAY

Source: FHWA, Scenario Planning for Connected and Automated Vehicles, DRAFT Scenario Descriptions, December 2017 .

Scenario Name	Scale Ratings			Brief Description
	Connectivity	Automation	Cooperation	
Slow Roll	Low	Low	Low	Minimum plausible change; nothing beyond currently available technology and investments already in motion
Niche Service Growth				Innovation proliferates, but only in special purpose or "niche" applications
Overall System	Low	Low	Low	
Niche Services	High	High	High	
Ultimate Traveler Assist	High	Low	Medium	CV technology progresses rapidly, but AV stagnates
Competing Fleets	High	High	Low	TNC-like services proliferate rapidly, but do not operate cooperatively
Managed Automated Lane Network				Certain lanes become integrated with CV and AV
Overall System	High	Medium	Low	
AV lanes	High	Medium	High	
RoboTransit	High	High	High	On-demand shared services proliferate and integrate with other modes via cooperative data sharing, policies, and infrastructure

Source: Scenario Planning for Automated Vehicles, November 6, 2017

Integrating ACES into the Planning Process



ACES Supportive Projects

Road Maintenance *(State of Good Repair)*	Lane marking improvements/maintenance for machine vision Pavement Lane marking maintenance improvements for safe automated vehicle operation improvements Pavement maintenance
Travel Lanes *(Capacity)*	Conversion of on-street parking to other uses Designation/planning of AV-only limited access arterial lanes or AV only transportation zones
Curb Management *(Shared Mobility)*	Designated pick-up/drop-off zones Curbspace value capture policy plans
Parking *(Land Use/Urban Design)*	Activity center master plans to guide conversion of parking Conversion of public parking facilities ACES parking priority Electric vehicle charging stations and related support systems
Transit *(Trunk and Feeder)*	Transit plans to guide investments in urban corridors Dedicated high-occupancy AV expressway and arterial lanes Mobility hubs First/last mile or paratransit partnership opportunities
Freight *(Long-Haul and Local)*	Dedicated AV truck corridors Suburban/weigh station truck terminals Intermodal terminal automation Lane management and restrictions planning
Smart Cities *(Internet of Things)*	V2I roadside units Traffic signal prioritization and interconnects Transportation operations management centers/upgrades Transportation data processing centers Fleet management facilities

Use Cases of Vehicle Automation

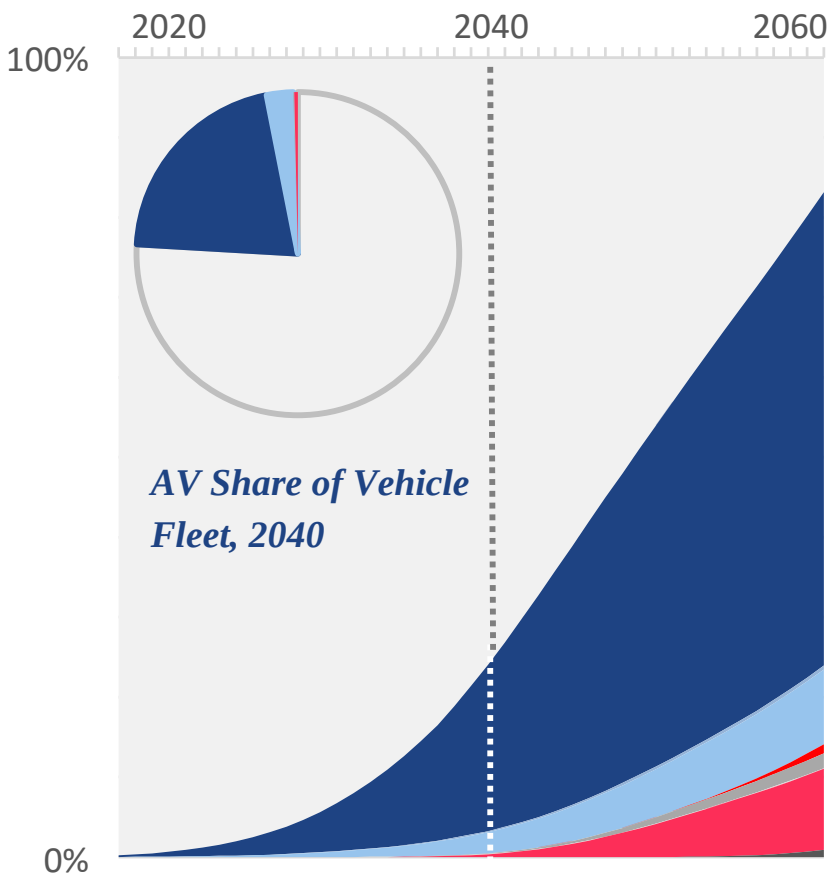
Level 2-3

- Cars and Light Trucks
- Vans and Buses
- Heavy Trucks

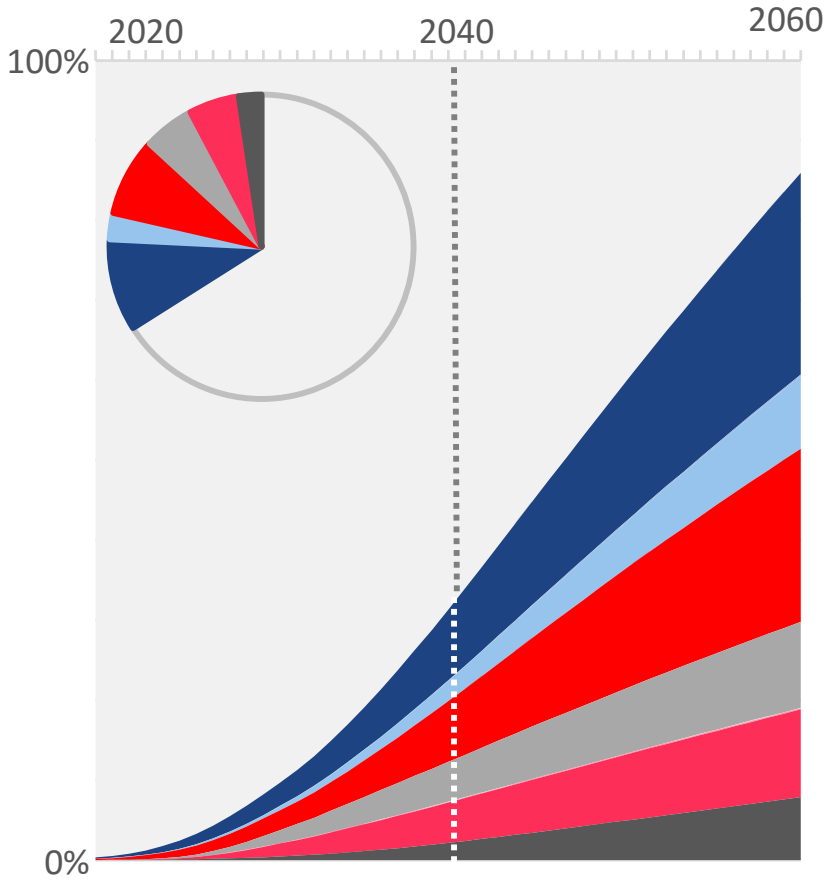
Level 4-5

- Cars and Light Trucks
- Low Speed Shuttles
- Taxis
- Van/Bus
- Urban Delivery
- Heavy Trucks

Slow Roll
AV Share of Vehicle Fleet



RoboTransit
AV Share of Vehicle Fleet

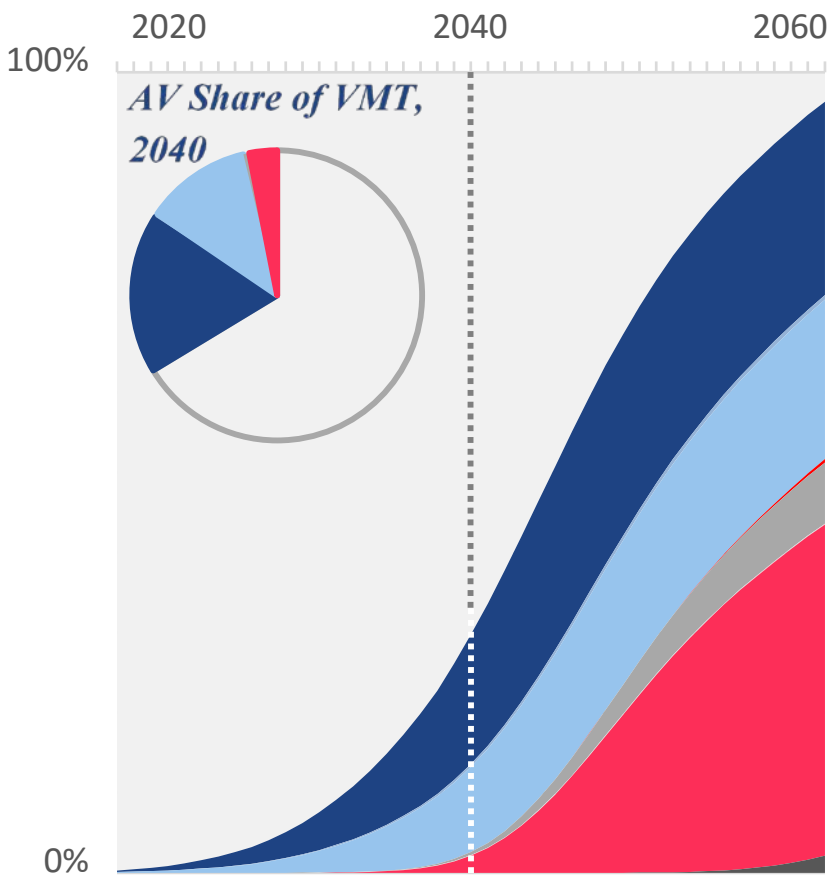


Level 0-1
- Conventional Vehicles

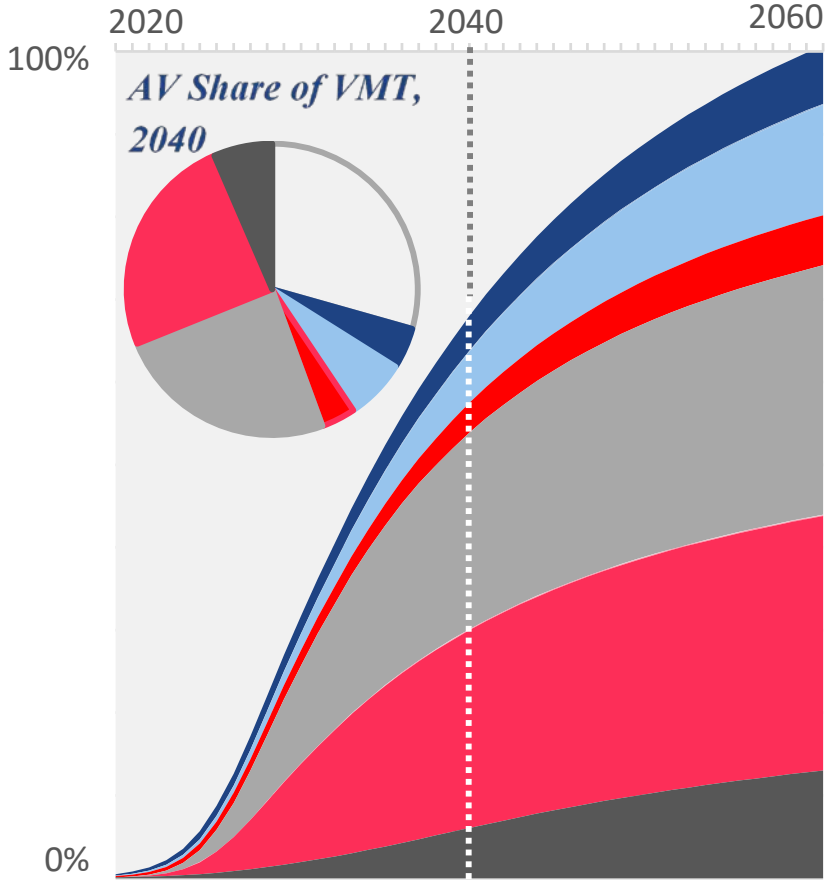
Level 2-3
- Cars and Light Trucks
- Vans and Buses
- Heavy Trucks

Level 4-5
- Cars and Light Trucks
- Low Speed Shuttles
- Taxis
- Van/Bus
- Urban Delivery
- Heavy Trucks

Slow Roll
AV Share of VMT



RoboTransit
AV Share of VMT



Level 0-1

- Conventional Vehicles

Level 2-3

- Cars and Light Trucks
- Vans and Buses
- Heavy Trucks

Level 4-5

- Cars and Light Trucks
- Low Speed Shuttles
- Taxis
- Van/Bus
- Urban Delivery
- Heavy Trucks

Level 2-3 Cars and Light Trucks

Source: Tesla (tesla.com/modelx)

- Largely household ownership
- Shared use limited to rental fleets, ridesourcing, and carsharing

Level 2-3 Cars and Light Trucks

Road Design Impacts	VMT Impacts	Parking Impacts	Urban Form Impacts	Other Impacts
 1	 11	 26	 33	 44
 2	 12	 27		

1 – Driving systems increase need for lane marking maintenance.

2 – Connected vehicle lanes on highways facilitate platooning, increasing capacity.

11 – Easier driving on freeways and in traffic increases tolerance for longer commutes.

12 – Electrification reduces cost of vehicle operation, promoting more and/or longer trips.

26 –Remote parking capability expected to allow for smaller parking spaces.

27 – Electrification likely to increase need for chargers at homes and destinations.

33 – Remote parking expected to reduce need for physical proximity of parking and uses. Reduced emphasis on parking availability near main entrance contributes to more walkable site design.

44 – Broad adoption may reduce crash rates.

Level 2-3 Heavy Trucks

- Largely fleet ownership

Source: VentureBeat (venturebeat.com/2017/04/13/peloton-raises-60-million-to-improve-truck-platoon-safety-and-efficiency-through-automation)

Level 2-3 Heavy Trucks

Road Design Impacts	VMT Impacts	Parking Impacts	Urban Form Impacts	Other Impacts
1	13			44
2	14			

1 – Driving systems increase need for lane marking maintenance.

2 – Connected vehicle lanes on highways facilitate platooning, increasing capacity.

13 – Improved working conditions may reduce truck driver shortage, leading to diversion of some shipments from rail to truck.

14 – Platooning and electrification expected to reduce fuel consumption, reducing costs and potentially leading to diversion of some traffic from rail to truck.

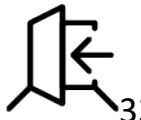
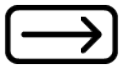
44 – Broad adoption may reduce crash rates.

Level 4-5 Cars and Light Trucks

- Largely household ownership
- Shared use limited to rental fleets and carsharing

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

Level 4-5 Cars

Road Design Impacts	VMT Impacts	Parking Impacts	Urban Form Impacts	Other Impacts
 1	 12	 26	 33	 44
 2	 15	 27	 34	
 3	 16			
 4	 17			

1 – Driving systems increase need for lane marking maintenance.

2 – Connected vehicle lanes on highways facilitate platooning, increasing capacity.

3 – Connected vehicle lanes at arterial intersections may increase capacity.

4 – Road construction, emergencies, and other temporary conditions require fleet operators or subscription services to divert vehicles to other routes.

12 – Electrification reduces cost of vehicle operation, promoting more and/or longer trips.

15 – Fully automated driving may reduce disutility of travel, promoting more and longer trips.

16 – Greater mobility for non-driving populations increases demand for travel.

17 – Reduced parking cost in remote lots may divert trips in dense urban centers from transit to auto.

26 –Remote parking capability expected to allow for smaller parking spaces.

27 – Electrification likely to increase need for chargers at homes and destinations.

33 –Remote parking expected to reduce need for physical proximity of parking and uses, potentially contributing to more walkable site design.

34 – Remote parking allows for conversion of parking lots and structures in urban centers, as well as some residential garages, to other uses.

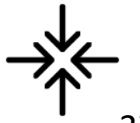
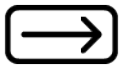
44 – Broad adoption may reduce crash rates.

Level 4-5 Taxis

- Almost exclusively public or private ridesourcing fleets

Source: Business Insider (businessinsider.com/gms-first-autonomous-car-will-be-electric-and-launch-on-lyft-2016-7)

Level 4-5 Taxis

Road Design Impacts	VMT Impacts	Parking Impacts	Urban Form Impacts	Other Impacts
 1	 16	 30	 35	 44
 2	 19		 36	 45
 3	 20		 37	 46
 4	 21		 38	
 7				

1 – Driving systems increase need for lane marking maintenance.

2 – Connected vehicle lanes on highways facilitate platooning, increasing capacity.

3 – Connected vehicle lanes at arterial intersections may increase capacity.

4 – Road construction, emergencies, and other temporary conditions require fleet operators or subscription services to divert vehicles to other routes.

7 – Increased need for curbside drop-off areas.

16 – Greater mobility for non-driving populations increases demand for travel.

19 – Automation likely to reduce cost of taxi services, shifting demand from buses to smaller vehicles.

20 – Reduced cost of mobility expected to increase number of trips.

21 – More efficient smartphone-based dispatching likely to offset some VMT growth with less deadhead compared to human-driven taxis.

30 – On-demand mobility services likely to reduce car ownership and demand for both residential and destination parking.

35 – Reduced parking demand expected to lead to conversion of parking lots and structures in urban centers, as well as some residential garages, to other uses.

36 – Parking areas near main entrances likely to transition to pick-up/drop-off areas.

37 – First-mile/last-mile services support consolidation of transit stops into high-amenity stations in major urban corridors.

38 – Fleet service centers likely to emerge on fringes of urban centers.

44 – Broad adoption may reduce crash rates.

45 – Reduced car ownership likely to have transformative impacts on automobile-dependent industries, including manufacturing, repair, driving, and insurance.

46 – New jobs created in mobility service control centers, vehicle fleet maintenance facilities, and support services.

Level 4-5 Vans and Buses

- Almost exclusively public or private transit fleets

Source: Daimler (daimler.com/innovation/autonomous-driving/future-bus.html)

Level 4-5 Vans and Buses

Road Design Impacts	VMT Impacts	Parking Impacts	Urban Form Impacts	Other Impacts
 1	 22	 30	 39	 47
 8	 23			 48

1 – Driving systems increase need for lane marking maintenance.

8 – Dedicated road space in major urban corridors provides priority to high occupancy vehicles and may facilitate high degree of automation sooner.

22 – Reduced transit operating costs allow more frequent service in major urban corridors.

23 – Reduced transit operating costs may support fixed route services in lower density settings, such as connections between suburban campuses and transit corridors.

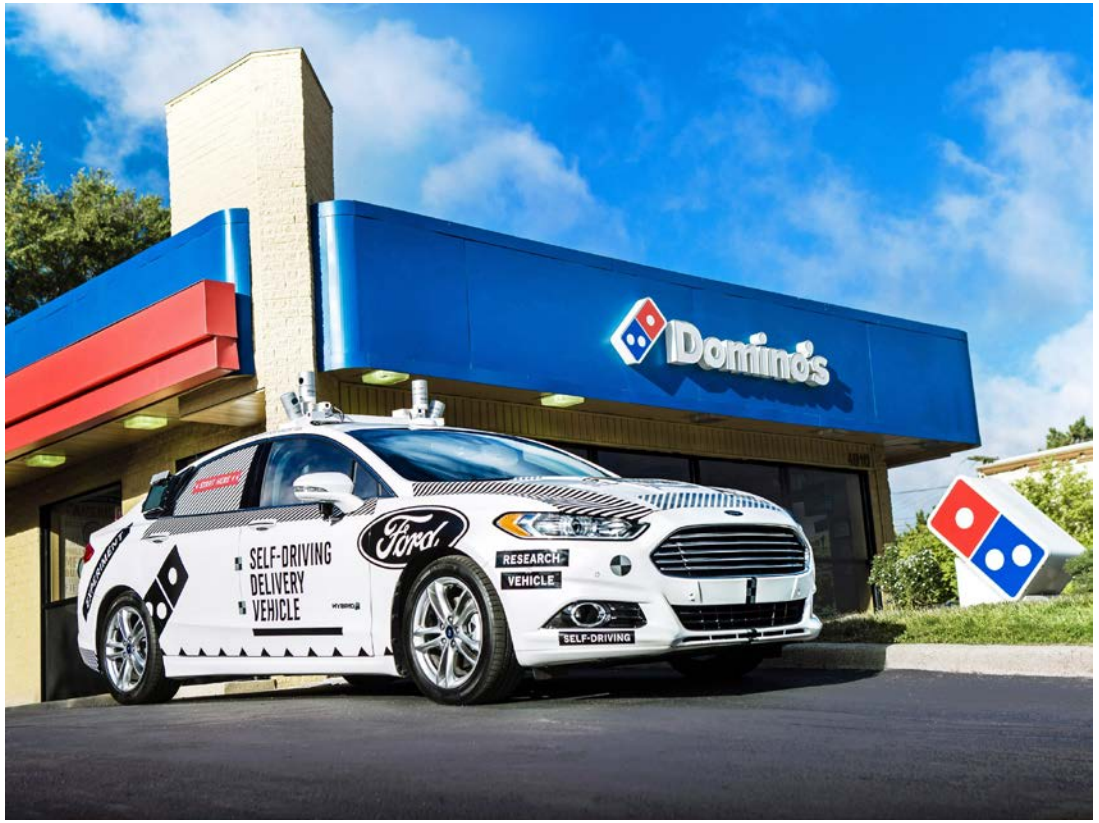
30 – On-demand mobility services likely to reduce car ownership and demand for both residential and destination parking.

39 – Dedicated transit priority corridors encourage transit-supportive development patterns around stations.

47 – Mix of public and private transit operators likely as taxi companies aggregate trips into larger vehicles in major urban corridors.

48 – Transit automation may reduce demand for bus drivers, potentially offset by increased service frequency in major corridors and new control center jobs.

Level 4-5 Urban Delivery



Source: Wired (wired.com/story/ford-self-driving-pizza-delivery-dominos/)

- Almost exclusively fleet ownership
- Many variations likely depending on cargo

Level 4-5 Delivery

Road Design Impacts	VMT Impacts	Parking Impacts	Urban Form Impacts	Other Impacts
 1	 12		 38	 44
 2	 24		 42	 51
 3				 52
 9				
 10				

1 – Driving systems increase need for lane marking maintenance.

2 – Connected vehicle lanes on highways facilitate platooning, increasing capacity.

3 – Connected vehicle lanes at arterial intersections may increase capacity.

9 – Increased need for curbside and off-street loading zones.

10 – Low-speed delivery vehicles share space with pedestrians, requiring new intersection control systems in urban centers and potentially wider sidewalks.

12 – Electrification reduces cost of vehicle operation, promoting more and/or longer trips.

24 – New business models built on low-cost driverless delivery likely to generate demand for more trips.

38 – Fleet service centers likely to emerge on fringes of urban centers.

42 – Transition to on-demand delivery likely to further reduce demand for traditional brick-and-mortar retail uses, especially outside urban centers.

44 – Broad adoption may reduce crash rates.

51 – Retail industry continues transition from selling physical goods to providing individualized services and experiences in urban shopping centers.

52 – Food service industry may transition to more delivery-based business models.

Level 4-5 Heavy Trucks

- Almost exclusively fleet ownership

Source: Auto Blog (autoblog.com/2015/05/06/freightliner-inspiration-truck-first-autonomous-semi-nevada)

Level 4-5 Heavy Trucks

Road Design Impacts	VMT Impacts	Parking Impacts	Urban Form Impacts	Other Impacts
1	12	32	43	43
2	25			53
3				

1 – Driving systems increase need for lane marking maintenance.

2 – Connected vehicle lanes on highways facilitate platooning, increasing capacity.

3 – Connected vehicle lanes at arterial intersections may increase capacity.

12 – Electrification reduces cost of vehicle operation, promoting more and/or longer trips.

25 – Automation reduces operating costs, leading to diversion of some traffic from rail to truck.

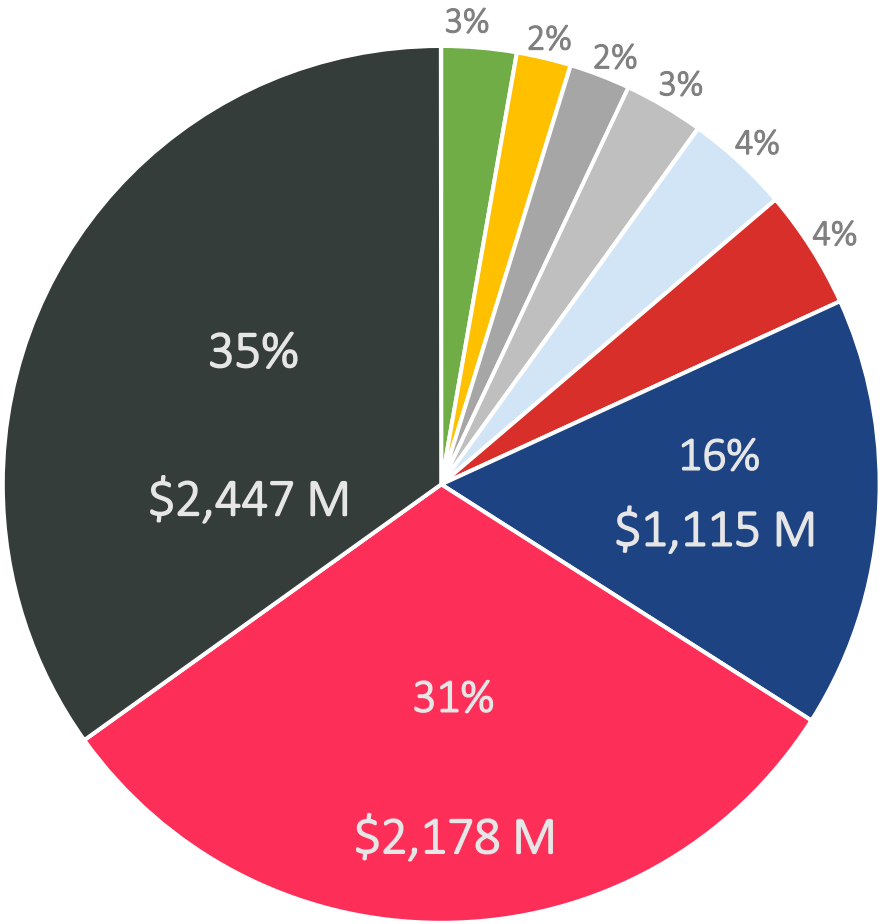
32 – Less use of human drivers for long-haul trucking reduces demand for truck plazas near highway interchanges.

43 – Truck terminals needed near highway interchanges to transfer loads between large trucks and urban delivery vehicles.

53 – Trucking industry jobs may shift from driving to fleet control centers, vehicle maintenance, and logistics hubs.

Close-up: Electric Vehicles

Florida State Transportation Trust Fund
Fiscal Year 2015 – 2016 Receipts in $Millions

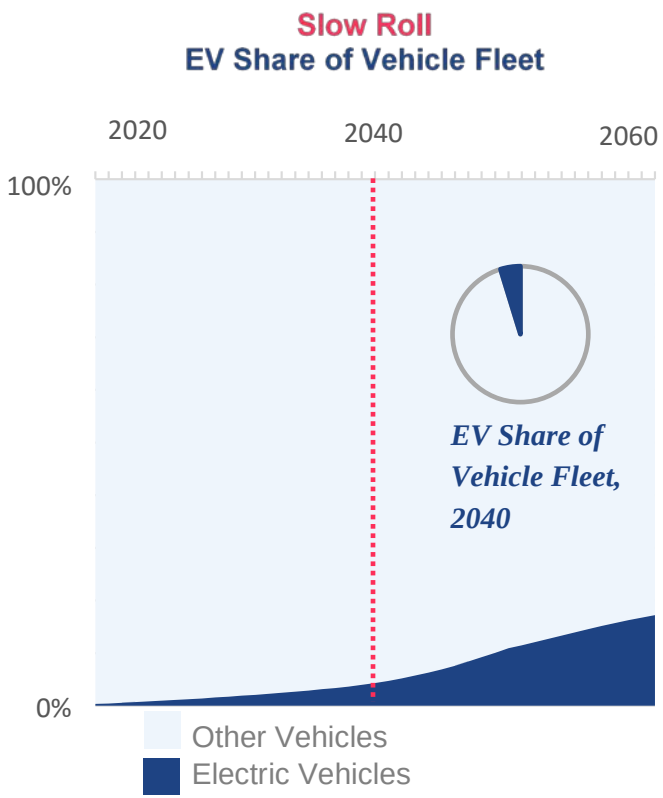


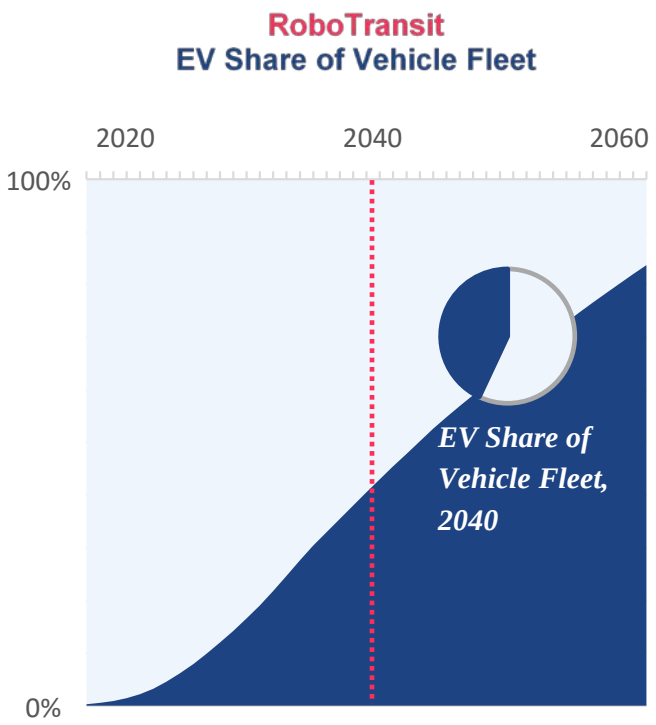
- Other
- Rental Car Surcharge
- Miscellaneous Revenue
- Reimbursement/Turnpike
- Documentary Stamps
- Joint Participation Agreements/Other Reimbursements
- Motor Vehicle Fees
- Fuel Taxes
- Federal Aid

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

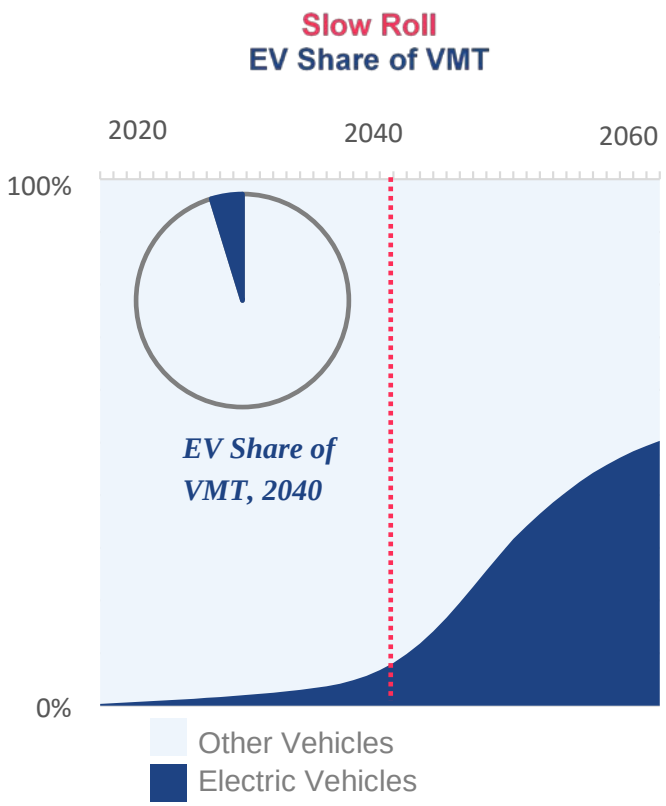


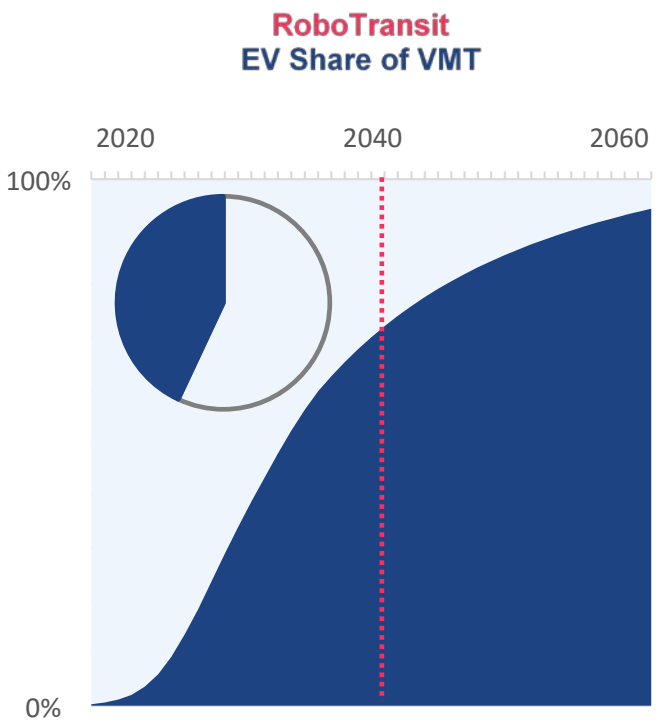


Conditions affecting EV impact:

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

EVs and their impacts





Conditions affecting EV impact:

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Alternative revenue models

OReGO
First large road usage charge program in US. Opt-in participants pay 1.5 cents per mile.

California Road Charge
Pilot program initiated through CalSTA that included 5,000 volunteers.

Nevada Field Test
Included 40 participants in a pay-at-the-pump system (not reliant on collection of location data).

Minnesota Road Fee Test
DOT tested road usage revenue program that relied on smartphone GPS data for collection and transmittal of mileage data for 500 participants.

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

Next steps


FDOT
METROPOLITAN AND
TRANSPORTATION
PLANNING ORGANIZATION
STATE OFFICE OF POLICY PLANNING
GUIDANCE
AUTOMATED, CONNECTED, ELECTRIC
AND SHARED-USE VEHICLES
APRIL 2018

Questions and discussion

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

Source: *Buick Avista Concept interior*
(http://st.motortrend.com/uploads/sites/5/2016/01/Buick-Avista-concept-interior-5.jpg)