

# Autonomous Vehicle and Alternate Fuel Vehicle FL Market Penetration Rate and VMT Assessment Study

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*Autonomous and Connected Mobility Evaluation*

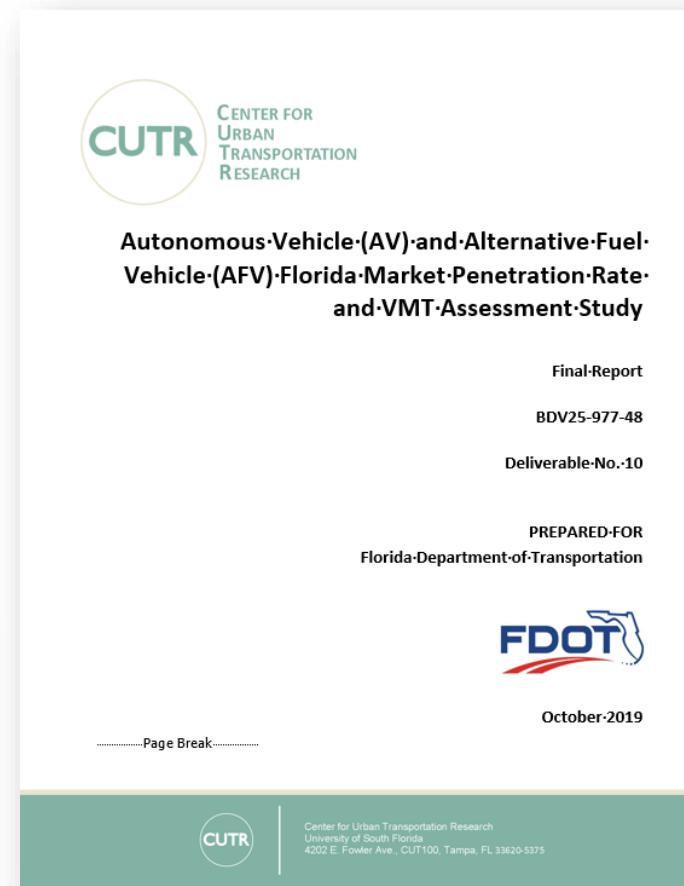
**Florida Metropolitan Planning Organization Advisory Council**  
**Orlando, January 30, 2020**



University of South Florida  
Center for Urban Transportation Research

# Background

- Autonomous Vehicle (AV) and Alternative Fuel Vehicle (AFV) Florida Market Penetration Rate and VMT Assessment Study
- Funded by FDOT
- 24-month project
- Completed: October 2019



# Reasons for Analysis

- To effectively plan and create a transportation system for the future, it is important for the state to consider AFV and AV market penetration scenarios and their potential impact on the state's vehicle miles traveled (VMT).
  - What impact will AFV and AV will have on transportation revenues?
  - What additional investments may be needed to facilitate their adoption?
  - What potential savings may be realized?



# Project Objectives

1. Conduct a comprehensive market penetration analysis of autonomous (AV) and alternative fuels vehicles (AFV) and their impact on the state's VMT over 30-year period
2. Produce high, medium, and low projections of market penetration rates and VMT
3. Estimate the impact to current motor fuel-based revenue sources
4. Identify potential investments needed and anticipated cost savings
5. Identify policy considerations for further development by FDOT and policymakers for transportation infrastructure design, construction, maintenance, and operation

# AV Market Penetration Rate Analysis – U.S.

- Review of relevant studies relating increased AV market penetration to changes in VMT at the national level
- By 2035, AVs may make up about 11-14% of private vehicle fleet and approximately 35% of private-vehicle VMT
- AV technologies are expected to be adopted in luxury segment first
- Level 4 may be available in medium, small, and lower priced vehicle categories in the mid-2020s to early-2030s.
- Level 5 expected to have an impact in the mid- to late-2030s.
- Providing shared mobility to underserved population can add 2-14% to VMT



# AFV Current Market Analysis – U.S.

- Review of relevant studies/literature
- 361,000 EVs sold in 2018 (2% of LD sales), half in CA
- EV vehicle stock remains low – 0.37% of LD vehicles
- 160,000 NGV vehicles in U.S., mostly HD
- Primary driver of EV/PHEV sales – battery cost
  - Cost of automotive batteries decreased from \$1,000/kWh in 2010 to under \$200/kWh in 2018
  - Projected to fall below \$100/kWh in 2025-2030 (EV will become comparable in price to ICE)



Other factors influencing EV market: government policy, consumer awareness, fueling infrastructure

# AFV Market Forecast – U.S.

- Projections vary significantly from source to source
- National forecasts imply short-to medium-term (10-15 years) annual growth rates of EV sales of 20.6%-25.1%;  
long-term (20+ years) growth: 7.5% - 16% per year.
- NGV sales: 10% of new MD and HD
- Fuel cell vehicle: 0.6% of total vehicle sales
- National EV stock projections range from 7 million vehicles in 2025, to 15 million vehicles in 2030 and to 41 million EVs in 2040
- EV fleet is not expected to exceed 15 percent of the overall U.S. vehicle stock in 2040.



# Florida VMT Projections

- Adjust FHWA long-term VMT forecast using weighted index of key demographic and macro-economic factors specific to Florida
- Multiple assumptions
- Categories of vehicles: LD vehicles, single unit trucks and buses, combination trucks
- Factors affecting VMT in Florida:
  - Population growth (higher than in U.S.)
  - Age (large percentage of 65+)
  - Population density (higher)
  - Household income (lower)
  - Geography and climate
  - Gasoline prices (lower)
  - AFV fueling infrastructure



# Florida eVMT Projections

## 1. Project number of EVs in Florida

- Adjust national trend using weighted indexes
- EV critical factors: growth in disposable income, gasoline prices, electricity rates, prices of PV, government rebates, etc.

## 2. Project average eVMT per EV (BEV & PHEV)

- BEV/PHEV split
- Improvements in battery technology/range

## 3. Combine number of EVs and eVMT

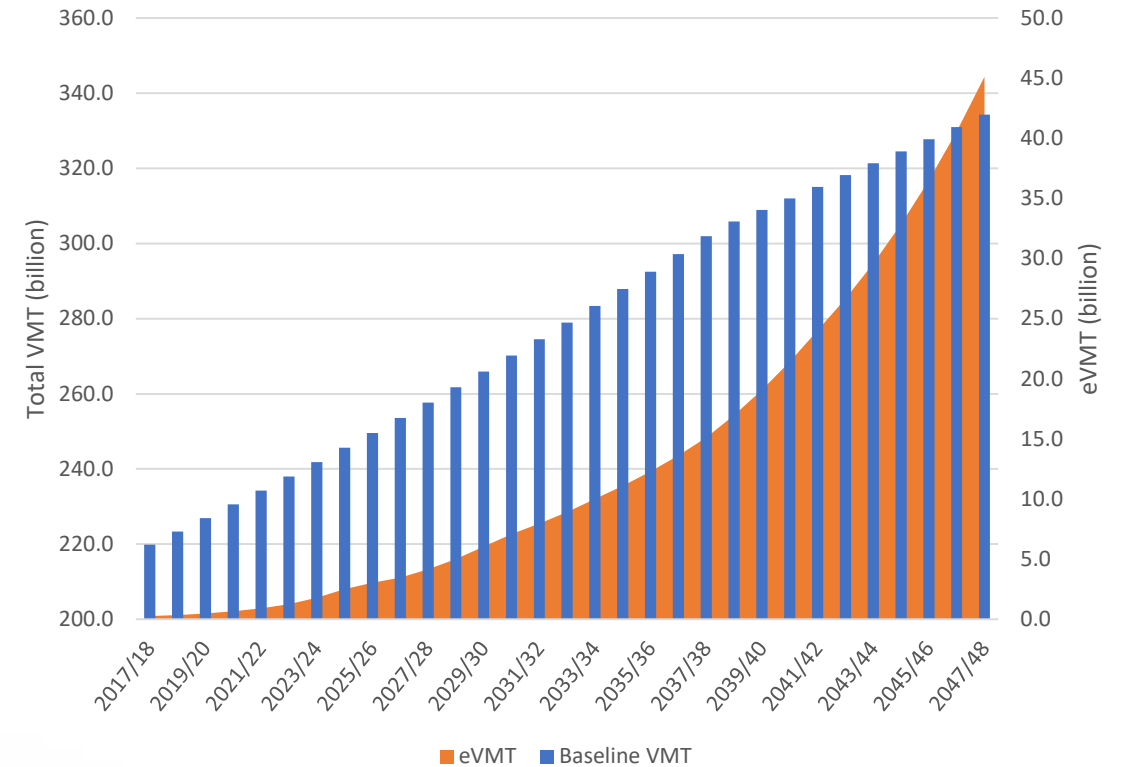
per EV to obtain total eVMT forecast

- LD, single-unit trucks/buses, combinations trucks



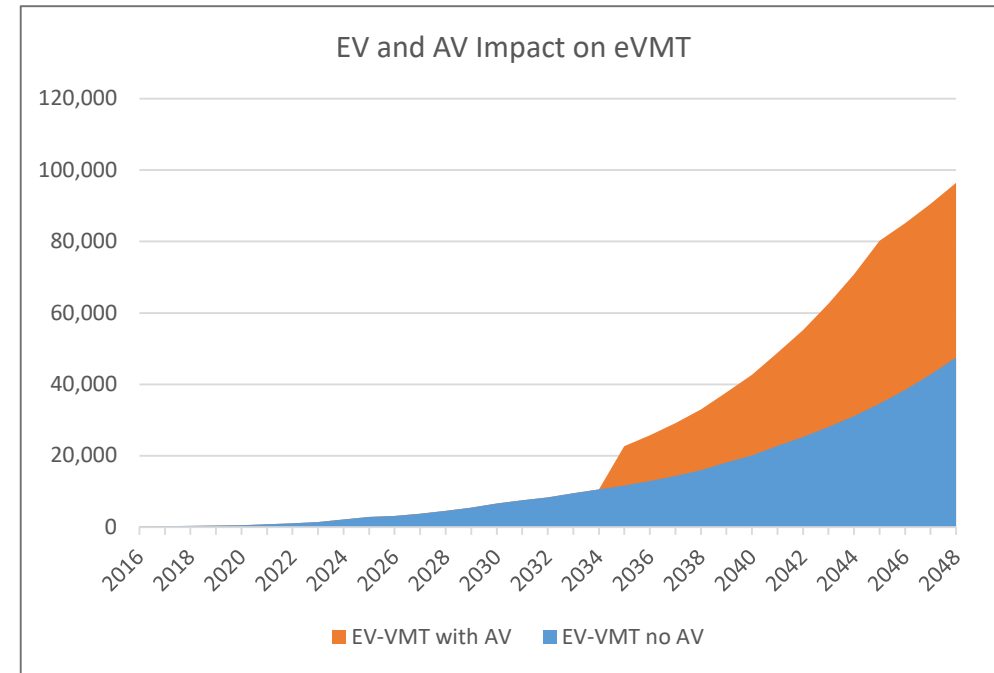
# AFV eVMT Projections – Florida

- Moderate eVMT growth until 2030
- EV market accelerates after 2030-2035
- By 2048, eVMT will reach 47.5 billion (14% of the VMT)



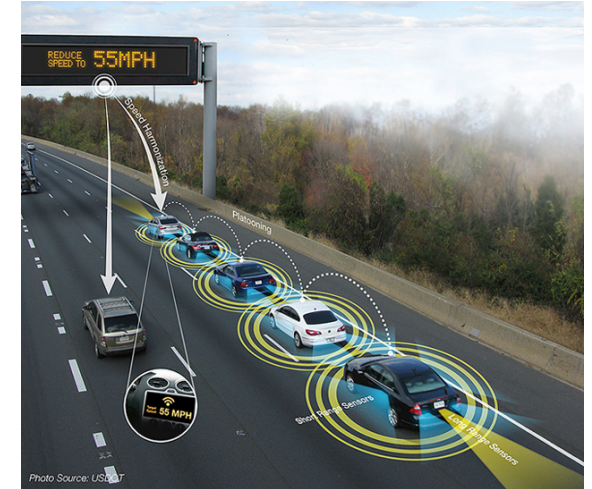
# AV VMT Projections – Florida

- Low penetration rate until 2030-2035
- Starting in 2035:
  - eVMT will grow by 12% per year
- By the end of 2048:
  - 43% of vehicle fleet will be AV
  - VMT will increase by 14.6%
- eVMT will account for 25.1% of total VMT in 2028
- Increased AV VMT fully absorbed by EV (eVMT)
- By end of 2048 AV will double eVMT



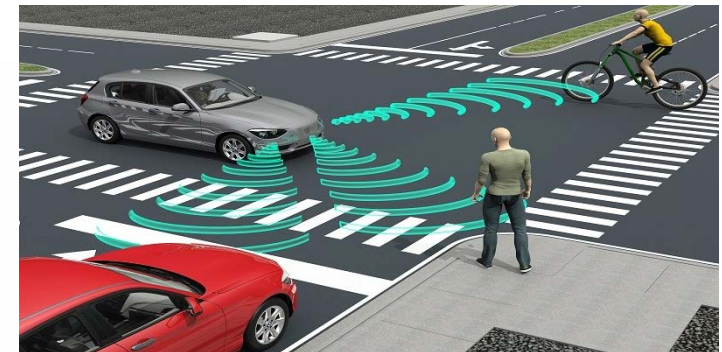
# AV and AFV Investment Requirement

- Most of AV capacity improvements will be achieved through vehicle cooperation
- Low levels of market penetration are associated with minimal capacity impacts
- As market penetration increases, the capacity increases remain minimal for non-cooperative AV but increase exponentially for connected AVs
  - 10%-40% connected AVs result in 12%-15% capacity increase
  - 100% connected AVs – 49%-270% capacity improvement
- Special infrastructure considerations for AVs: road markings and signage, managed/dedicated lanes, addition of drop-off lanes, ITS roadside devices (VTI), demand management strategies, etc.
- EV charging infrastructure needs in Florida (by 2040):
  - Additional 19,000 Level-2 public charging stations
  - Additional 2,350 DCFC



# AV and AFV Cost Savings

- Cumulative benefits for EV owners (2018-2048)
  - Fuel cost savings of \$15.6 billion
  - Life-cycle cost savings of \$40 billion
- HD vehicles will not demonstrate TCO savings until 2030-2035
- Significant savings can be expected from AVs:
  - Crash cost reductions (94% of all crashes can potentially be avoided)
  - Reduction in congestion (improvement in capacity)
- Capacity improvements do not eliminate the need to invest in road construction to address growth in travel demand

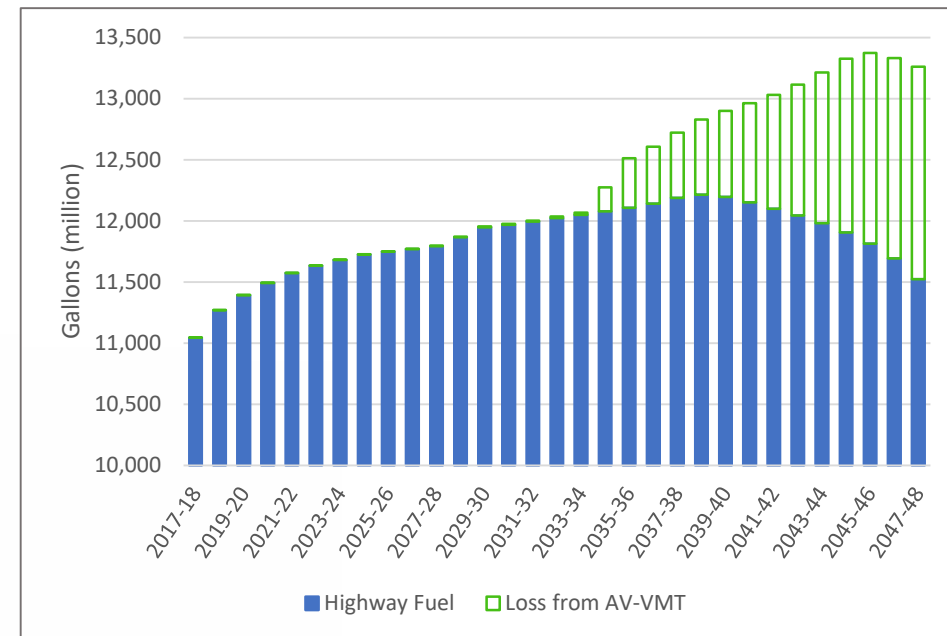
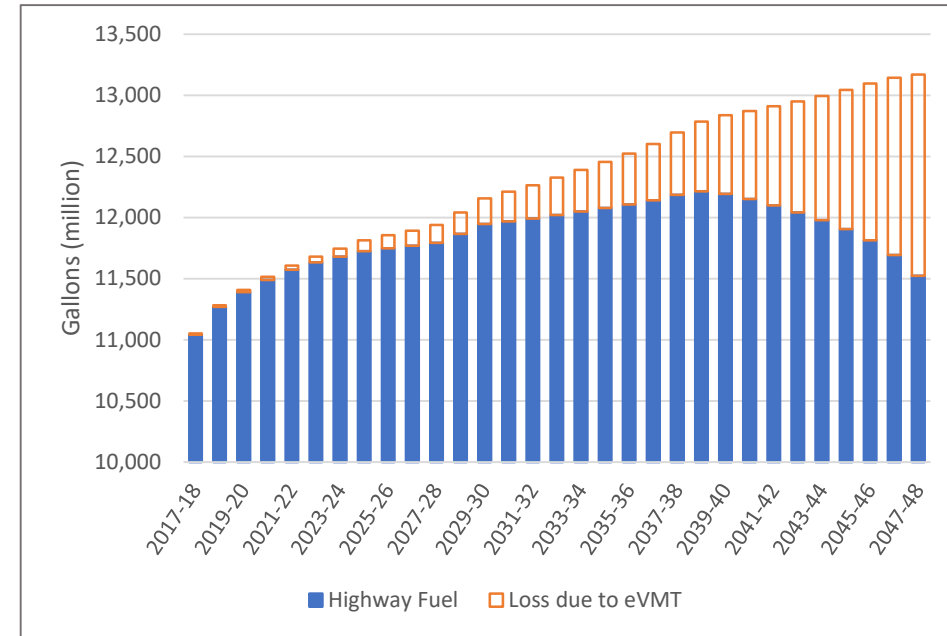


# Revenue Analysis

- Assess the impact of AV and AFV on state revenues
  - Federal – Federal Gas (18.4 cents/gal); Federal Diesel Added 6 cents/gal
  - State – State Sales (14.1 cents/gal); SCETS (7.8 cents/gal); 7-percent of 1-6 cents local option
  - Local Option – 1-6 cents/gal; local option 1-5 cents/gal; 9 cents/gal; constitutional, county, and municipal.
- Some are automatically adjusted to CPI, others are adjusted periodically by legislative actions
- Use approach by Florida Office and Demographic Research Revenue Estimating Conference (REC). Extend to FY 2047- 48.
- Employ forecasts of vehicle fleet composition, MPG, VMT, etc.

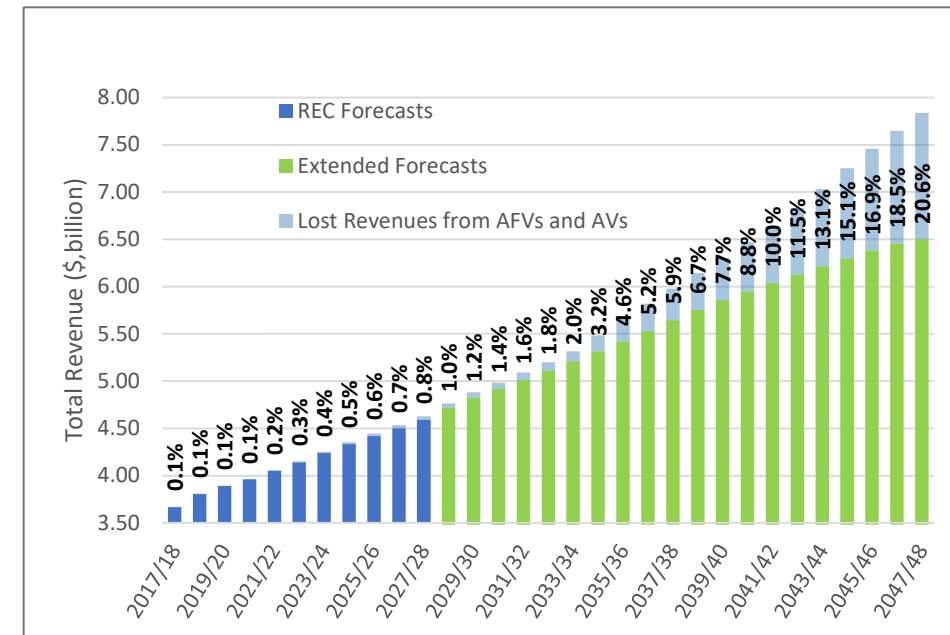
# Impact from AFV and AV on Highway Fuel

- Fuel consumption decreases after 2039
- By FY 2047-48 increased AFV market penetration will reduce demand for motor fuel by 1.6 billion gallons annually
- By FY 2047-48 AVs will reduce highway fuel demand by about 1.7 billion gallons annually



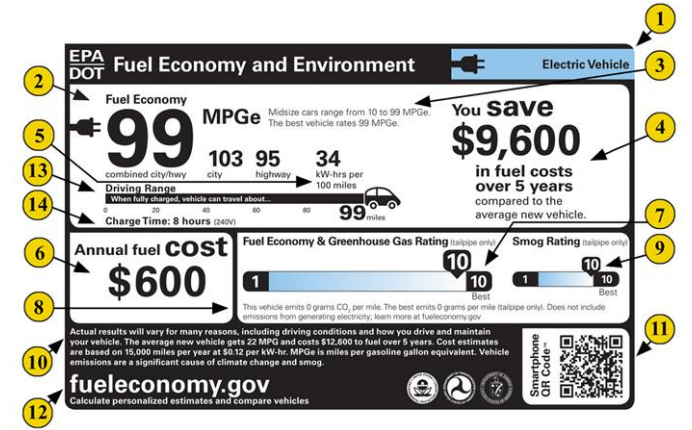
# Combined Impact of AFV and AV on Revenues

- Cumulative Revenue Loss over 30-year period
  - \$18.3 Billion federal, state and local
  - \$9.7 Billion loss from states sales
  - 8.6% of state revenues
  - Revenue loss until FY 2027-28 is insignificant
- By FY 2047-48 annual revenue losses will drastically increase
  - \$2.4 Billion/year
  - About 21 % of total revenues or 26 % of annual fuel-based state portion



# Factors Affecting the Projections

- Continuous improvements in ICE fuel efficiency not fully accounted for
- Average miles driven by EV and ICE
- PHEV utility factor (% of eVMT to total miles)
- Age of vehicle fleet
- EV and AV adoption rates
- Impact of EVs on fleet fuel efficiency
- Behavioral changes



Courtesy: EPA



Photo Source: USDOT

# Conclusions and Recommendations

- Identify policy-feasible alternatives that are revenue loss neutral and focused on infrastructure preservation.
- Conduct sensitivity analysis of selected policy options
- Continued monitoring of key trends affecting market adoption and VMT generation
- Update forecasts to include recent AFV-AV market developments and changes in regulation



# Thank you!



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