

# Implications of Market Penetration of AV and AFV to Florida Transportation Revenue and Infrastructure

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# Background

- Autonomous Vehicle (AV) and Alternative Fuel Vehicle (AFV) Florida Market Penetration Rate and VMT Assessment Study
- Funded by FDOT
- Project Team:
  - Sisinnio Concas – PI
  - Alexander Kolpakov – Co-PI
  - Austin Sipiora
  - Robyn Kibler
  - Braden Sneath
- 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 and prepare a set of revenue measures that address FDOT transportation funding needs
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, operations, and funding purposes

# 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 approximately 35% of private-vehicle VMT and 11-14% of private vehicle fleet.
- 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.
- Market penetration rates in long-distance trucking can range from 15% to 90% by 2032. By 2040, these rates can range from 25% to 100%
- 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),
- EV vehicle stock remains low - 0.37% of LD
- 160,000 NGV vehicles in U.S., mostly HD
- Primary driver of EV/PHEV sales - batt
  - Cost of automotive batteries decreased from \$1,000/kWh in 2010 to under \$200/kWh
  - Projected to fall below \$100/kWh in 2025 (EV will become comparable in price to ICV,



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% - 30%  
long-term (20+ years) growth: 7.5% - 16%
- 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
  - etc.



# Florida eVMT Projections

## 1. Project number of EVs in Florida

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



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

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

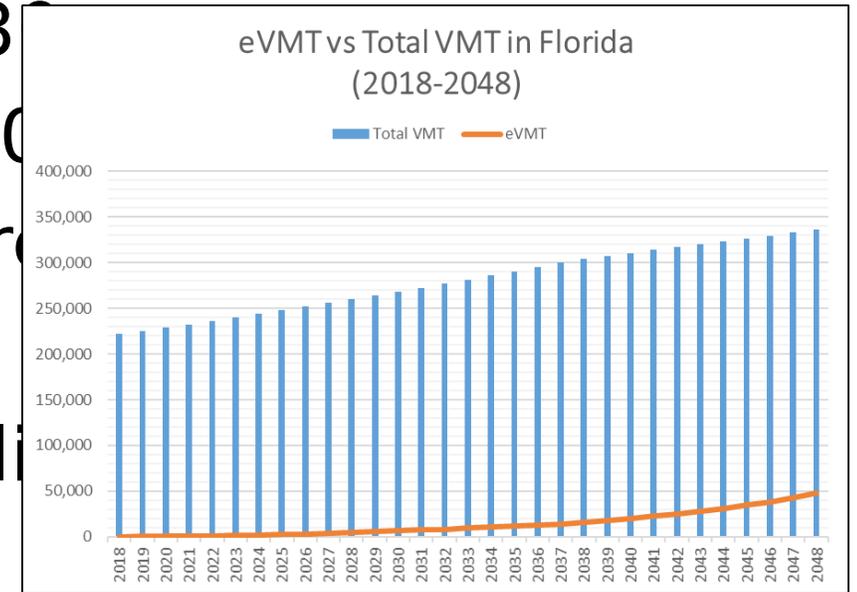
## 3. Combine number of EVs and eVMT

- per EV to obtain total eVMT forecast
- LD, single-unit trucks/buses, combinations



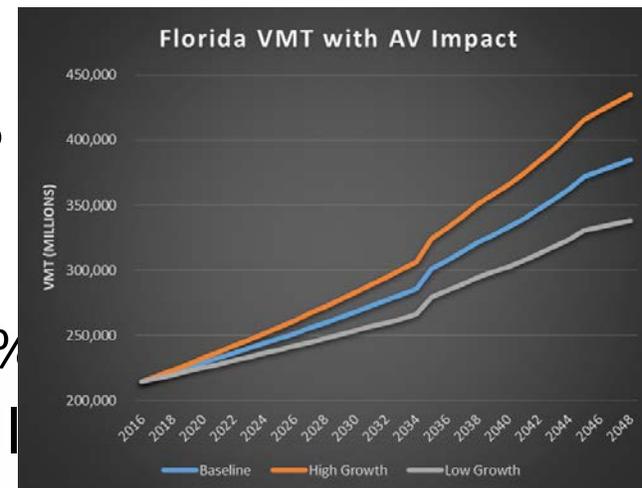
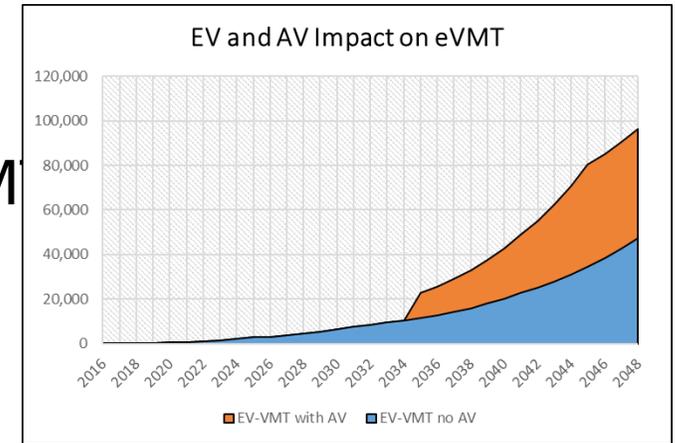
# AFV Market Penetration Rate and VMT Projection - Florida

- Moderate eVMT growth until 2030
- EV market accelerates after 2030
- By 2048, eVMT from EVs in FL are projected to reach 47.5 billion (14.1% of the overall VMT - baseline)
- In 2048, single-unit trucks and buses are projected to have the largest share of electric miles over other vehicle types (16.5%)
- Does not account for potential AV



# AV Market Penetration Rate and VMT Projection - Florida

- AV will double eVMT by 2048
- Increased AV VMT fully absorbed by EV (eVMT)
- Low penetration rate until 2030-2035
- Increase in Total VMT
- By 2035:
  - 25.4% of vehicles will be AV
  - increase baseline VMT by 3.8%
- By 2048:
  - 43% of vehicle fleet will be AV
  - increase baseline VMT by 14.6%
- eVMT to grow by 12% annually between 2035-2048.
- eVMT is projected to account for 25.1% of total VMT in 2028



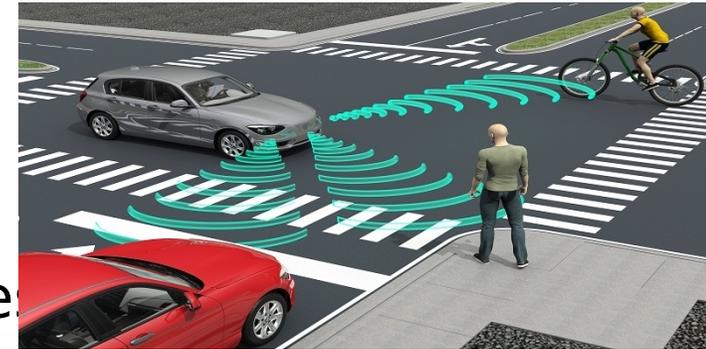
# AV and AFV Investment Requirement

- 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)
- At least a portion of AV benefits is negated by increases in VMT
- Capacity improvements do not eliminate the need to invest in road construction to address growth in travel demand



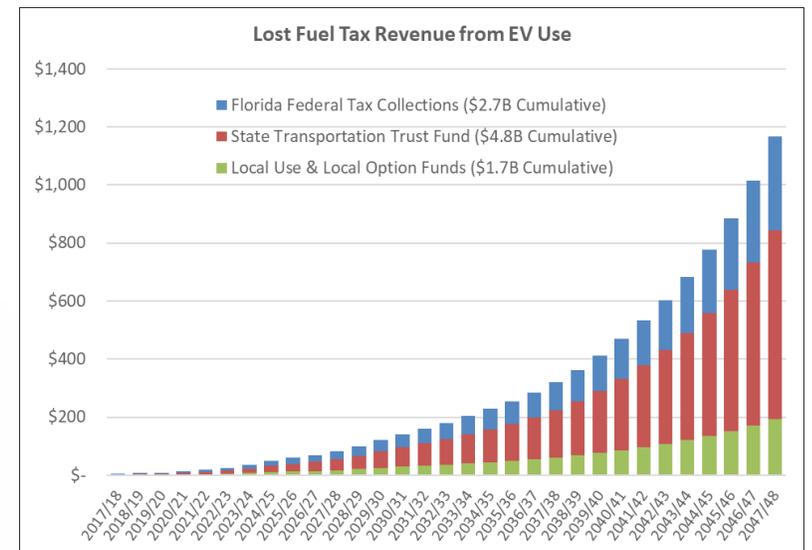
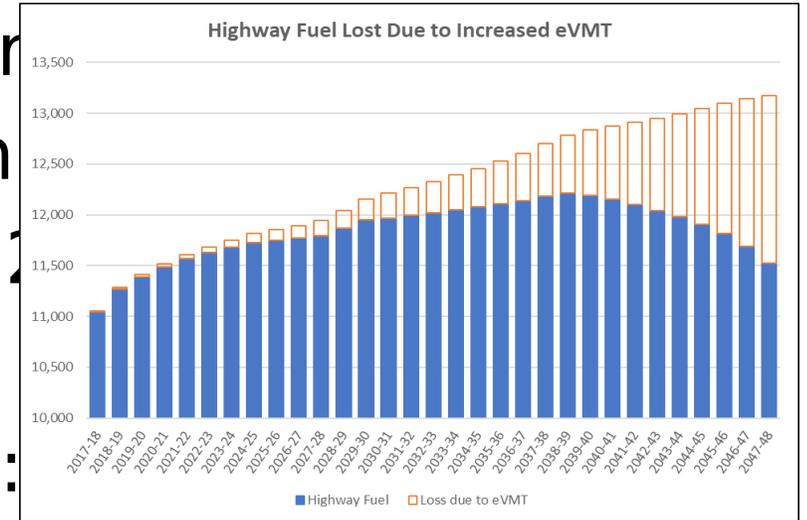
# Revenue Analysis

- Assess the impact of AV and AFV on state revenues
- Transportation Taxes:
  - Federal
  - State - fuel sales tax, SCETS tax, aviation fuel tax, fuel use tax, motor vehicle license tax, vehicle registration, rental car surcharge, etc.
  - Local - county fuel tax, municipal fuel tax, local option tax, etc.
- 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 2048.
- Employ forecasts of vehicle fleet composition, MPG, VMT, etc.



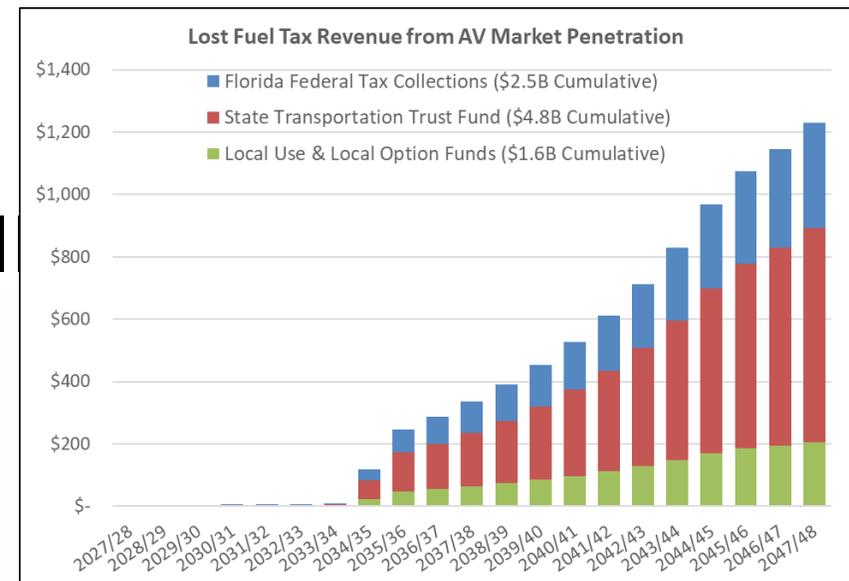
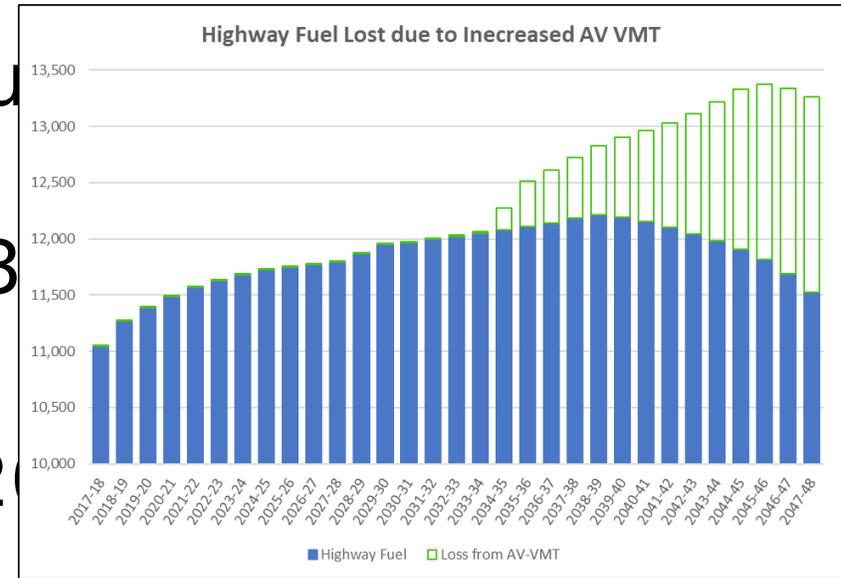
# Revenue Impact from AFV

- Increased AFVs reduce demand for motor fuel by 1.6 billion gallons in
- Fuel consumption decreases after 2
- Cumulative revenue losses (2028):
  - Federal - \$126.5M
  - State - \$165.8M
  - Local use taxes - \$83.2M
- Cumulative revenue losses (2048)
  - Federal - \$2.7B
  - State - \$4.8B
  - Local taxes - \$1.7B



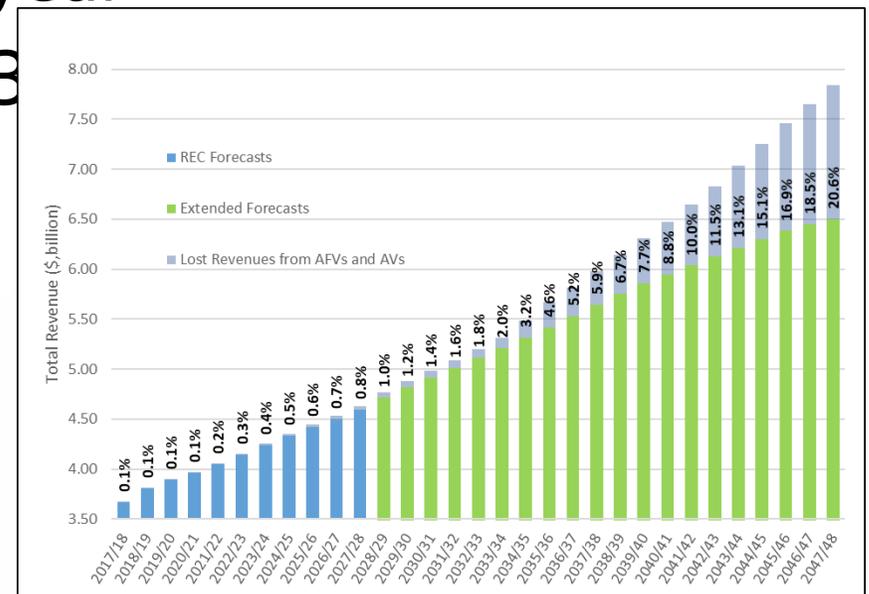
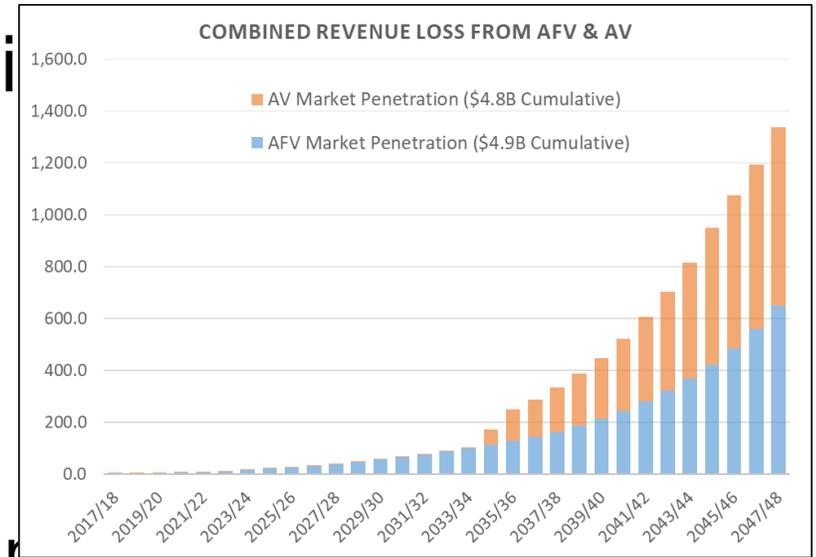
# Revenue Impact from AV

- Reduced demand for motor fuel
  - 1.7 billion gallons (2048)
- Impact is noticeable after 2033
- Cumulative revenue losses (2029-2048)
  - Federal - \$2.5B
  - State - \$4.8B
  - Local taxes - \$1.6B
- Annual STTF revenue shortfall
  - 2029 - \$1.3M
  - 2035 - \$58.7M
  - 2045 - \$527.4M



# Combined Impact of AFV and AV

- Revenue loss until 2028 is insignificant
- Tax revenue losses in 2048:
  - \$2.4B/year:
    - \$660M - federal
    - \$1.3B - state,
    - \$398M - local
  - Limited impact of NGV - \$1.5M/year
- Cumulative Revenue Loss for 30 Year Period (STTF) - \$9.7B
- Revenue Losses as % of STTF:
  - 2028 - 1.0%
  - 2048 - 20.6%



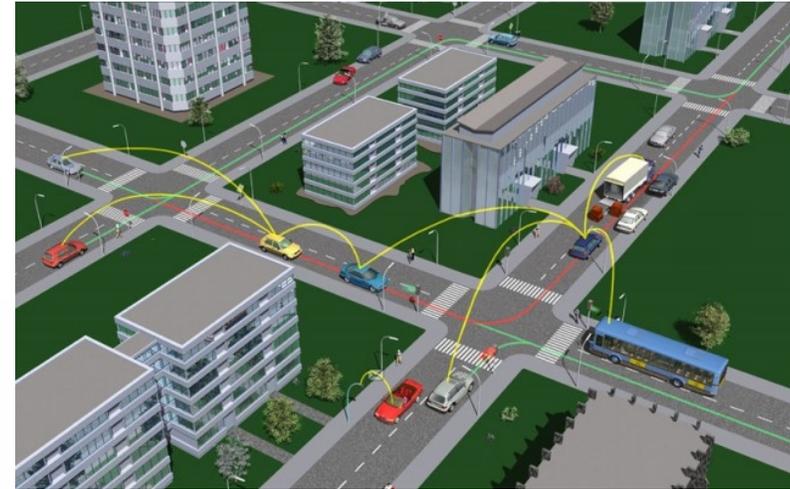
# Factors Affecting the Projections

- Average miles driven by EV and
- 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



# Policy Considerations

- AFV Fees and Taxes
- Public-Private Partnerships for Transportation Infrastructure
- Tolling and Congestion Pricing
- Road Use Fee/VMT Fee



# Recommendations

- Continued monitoring of key trends affecting AFV and AV market adoption and factors affecting VMT generation and their impact on state revenue funding
- Update forecasts to include recent AFV-AV market developments
- Conduct sensitivity analysis of selected policy options to address STTF funding shortfall



# Thank you!



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