USABILITY TESTING

of a New Activity-Based Travel Model for the Metropolitan Washington Region

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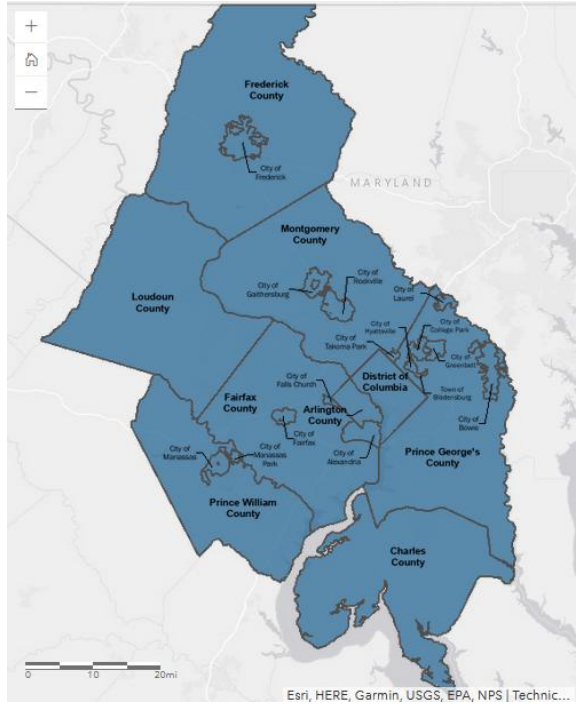
About MWCOG and NCRTPB

- Metropolitan Washington Council of Governments (MWCOG or COG) is an independent, nonprofit association.
  - Brings area leaders together to address major regional issues in the District of Columbia, suburban Maryland, and Northern Virginia.
  - Membership is comprised of 300 elected officials from 24 local governments, the Maryland and Virginia state legislatures, and U.S. Congress.
- National Capital Region Transportation Planning Board (NCRTPB or TPB) is the federally designated Metropolitan Planning Organization (MPO) for the region.
  - Prepares plans and programs that the federal government must approve in order for federal-aid transportation funds to flow to metropolitan Washington.



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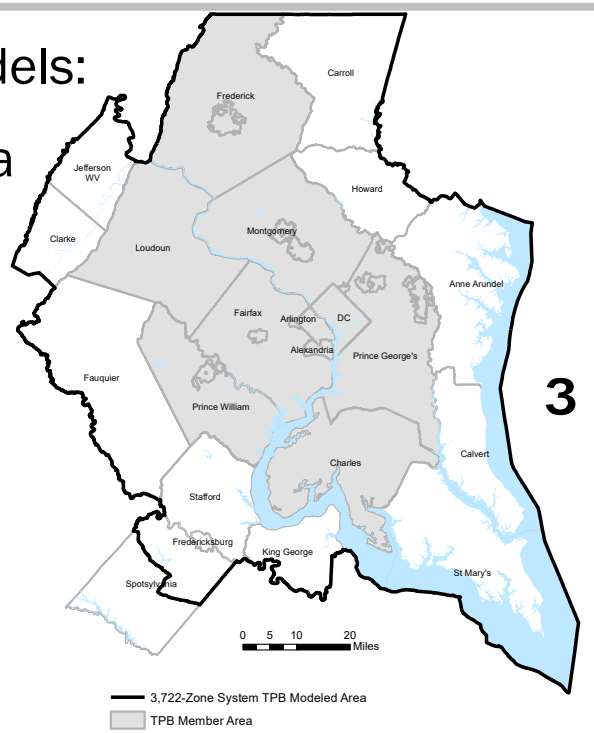
Model Overview: Gen2 and Gen3 Travel Models

- COG/TPB staff maintains at least two regional travel demand models:
  - One or more production-use models. Gen2/Ver. 2.4.6 Model, a trip-based model (TBM), is the current production-use model.
  - One or more developmental models:
    - The Gen2 Model
    - The Gen3 Model, an activity-based model (ABM) utilizing ActivitySim



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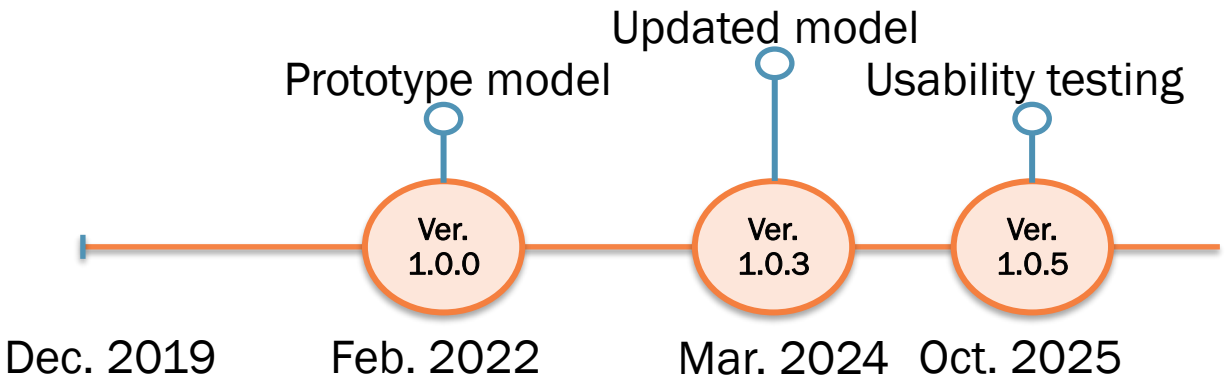

- 2.9 million households, 7.7 million people, 4.2 million jobs
- 6,800 sq. mi.
- 22 jurisdictions in DC, MD, VA, WV

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Usability Testing for the Gen3 Model: Overview

- Using both the production-use (Gen2) and developmental (Gen3) travel models to develop the Long-Range Transportation Plan (LRTP) and conducting sensitivity tests, mainly aiming to:
  - Compare Gen2 and Gen3 Model responses under similar conditions.
  - Showcase Gen3 Model's capability for in-depth analysis with disaggregate data.
  - Institute bug fixes and enhancements based on the findings.

	Gen2 Model	Gen3 Model
Model	TBM, calibrated to 2007-08 HTS/'07 ACS	ABM, calibrated to 2017-18 RTS/ '18 ACS
Network/project inputs	Both generated from the same active network database for the Visualize 2050 LRTP, but in different formats (Cube TRNBUILD vs Cube PT)	
Transit fare inputs	Aggregated transit fare zone matrix	PT fare specifications by operator
Land use inputs	Aggregate (TAZ level), COG's Cooperative Forecasts, Round 10.0	Disaggregate: Synthetic population generated using COG's Cooperative Forecasts, Round 10.0, Census data as controls

Usability Testing for the Gen3 Model: Scenarios

Simulated application in Visualize 2050

Analysis (regional statistics) for Air Quality Conformity Years (2025, 2030, 2045, 2050)

MOVES Motor Vehicle Emission Simulator

Emission modeling for 2025 and 2050

VISUALIZE 2050

Long-range transportation plan performance analysis

Sensitivity tests in hypothetical scenarios

Targeting overall 20% market share of Autonomous Vehicles (AVs) in the metropolitan Washington region (2045).

Increasing transit subsidy availability to full-time workers (2025).

Imposing cordon pricing for trips going to the CBD in DC (2025).

Increasing the telecommute frequency in the TPB Planning Area (2025).

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Analysis for Air Quality Conformity Years

- Consultant investigated/addressed model issues that COG staff noticed during usability testing for Gen3/Ver. 1.0.3.
  - Household trip rate under-estimation
  - Somewhat higher SOV share and lower HOV shares
  - Too few trips in midday and evening periods
  - Truck and Commercial Vehicle VMT increase

2017/2018 Region Travel Survey (RTS)

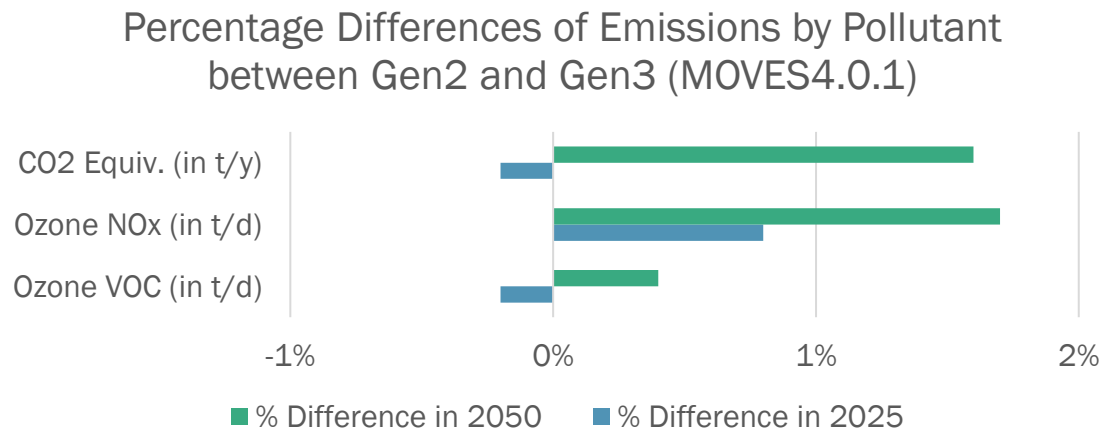
Gen2/Ver 2.4.6 Model

➡ The latest model validation performance largely satisfactory.

➡ The resulting Gen3/Ver. 1.0.4 closely matched with Gen2 on almost all resident/exogenous/total travel statistics, except for transit (due to recalibration/revalidation) and total VHT/VHD (due to TOD shift of traffic).

Emission Modeling

- After rerunning 2025 and 2050 scenarios in the Gen3/Ver. 1.0.4 Model, staff estimated emissions using both MOVES4.0.1 and MOVES5, a new MOVES model that EPA released in December 2024.
- Emission results from both MOVES models are very comparable between Gen2/v2.4.6 and Gen3/v1.0.4.

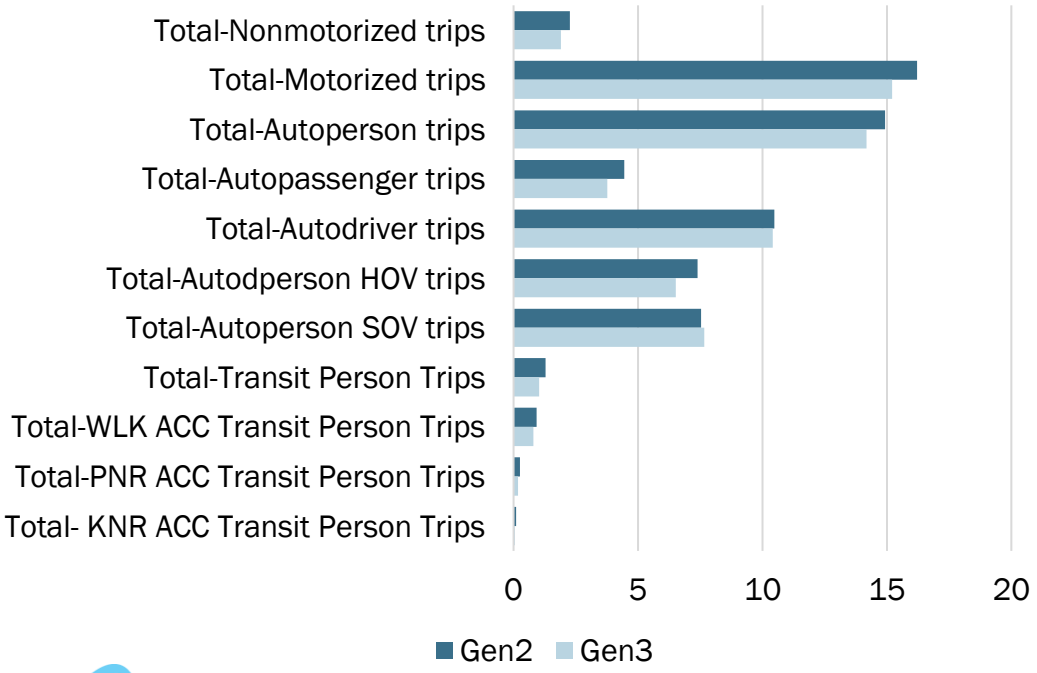


Note: Ozone non-attainment area for ozone pre-cursor pollutants (NOx & VOC); TPB Planning area for CO2 Equivalent.

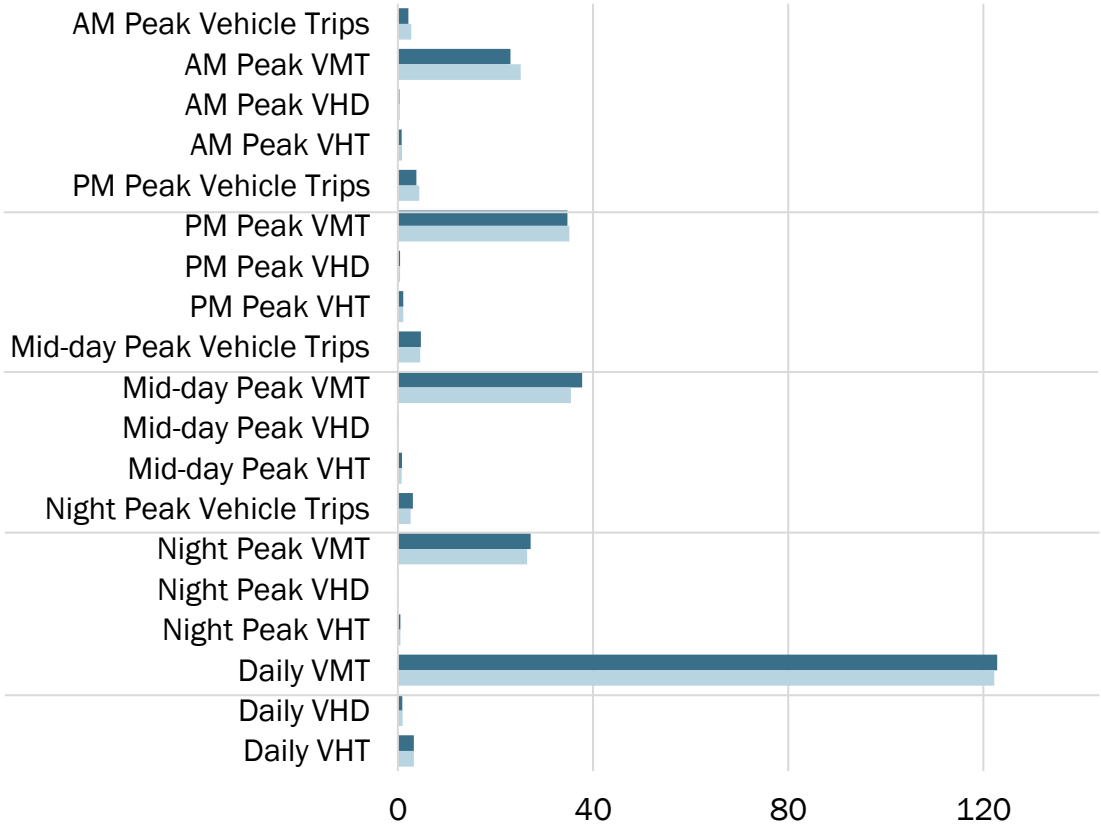
Performance Analysis of the LRTP

- This analysis assessed the performance of the Visualize 2050 LRTP by comparing travel forecasts before and after the plan implementation.
- Key travel demand and supply metrics are comparable.

Person Trips by Mode (in millions)



Highway Assignment Statistics by Time-of-Day (in millions)



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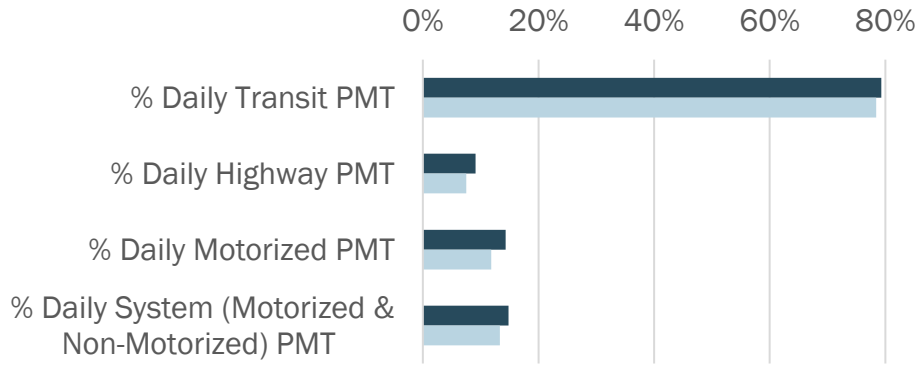
Performance Analysis of the LRTP (Cont.)

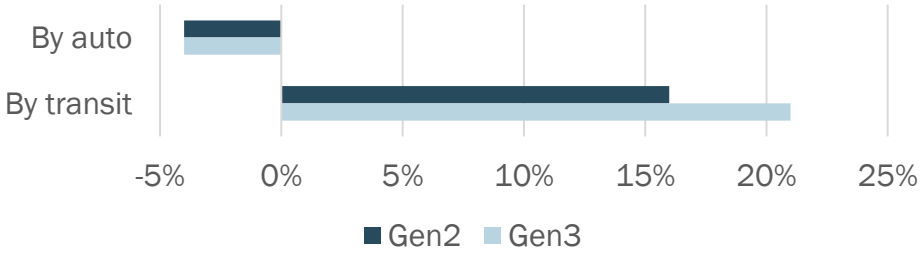
- Travel on reliable transportation modes, such as auto and transit, from the two models generally aligns well.

Share of Daily Person Miles of Travel (PMT) Using Reliable Modes by Travel Mode



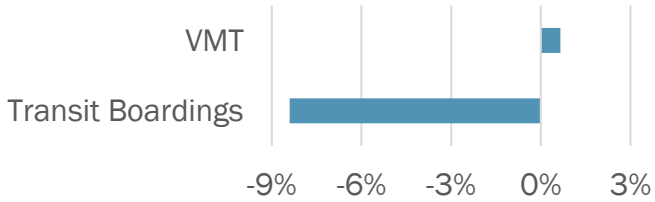
- Changes in job accessibility between the base year and horizon year:
  - Both models project a modest decline in average job accessibility by auto.
  - Job accessibility by transit increases in both models, with a larger increase in the Gen3 Model.

Change in Job Accessibility between 2025 and 2050



Autonomous Vehicle Scenario

Assumed **20%** market share of AVs by year 2045 in the region.

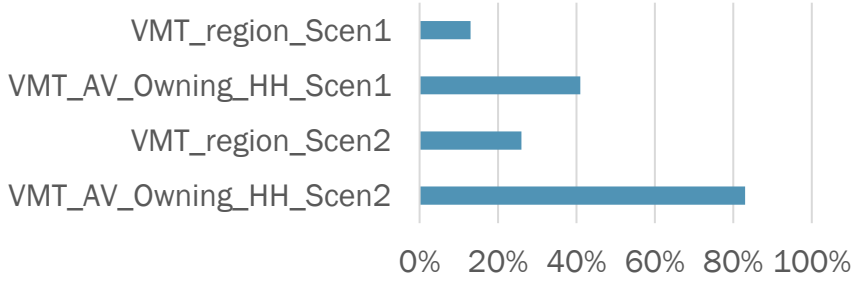


Gen3 Model shows inadequate system effects of AV. While the directionality is consistent with prior studies, the magnitude of change is much smaller than expectation.

- This can largely be attributed to the limitations of the AV specification in the Gen3 Model:
  - Only person travel is simulated – No representation of sophisticated AV behaviors such as AV trip chaining and repositioning ("deadheading").
  - Network models are not set up for AV - No congestion effects of unoccupied AV; No capacity or speed treatments (e.g., platooning, signal optimization, vehicle-to-infrastructure (V2I) connectivity, exclusive lanes).

AV Scenario: Extended AV Specification

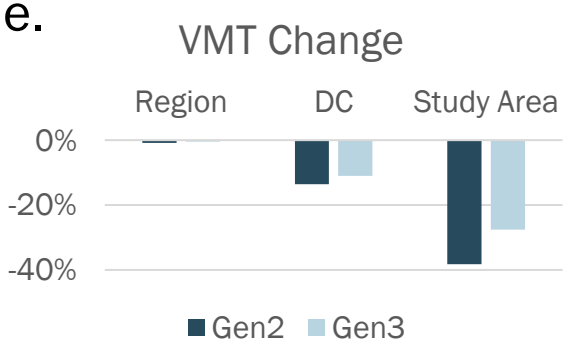
- Post-processing procedure: Simulating AV deadheading trips based on simplified assumptions and assigning them onto the highway network as a separate vehicle type.

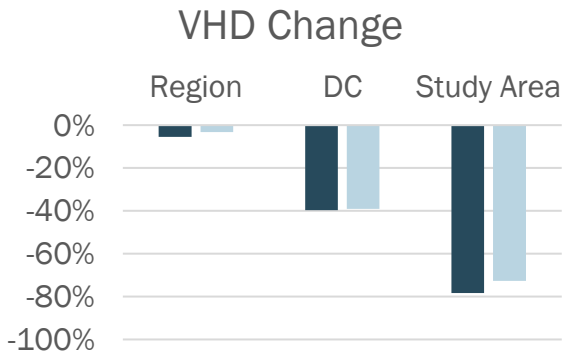


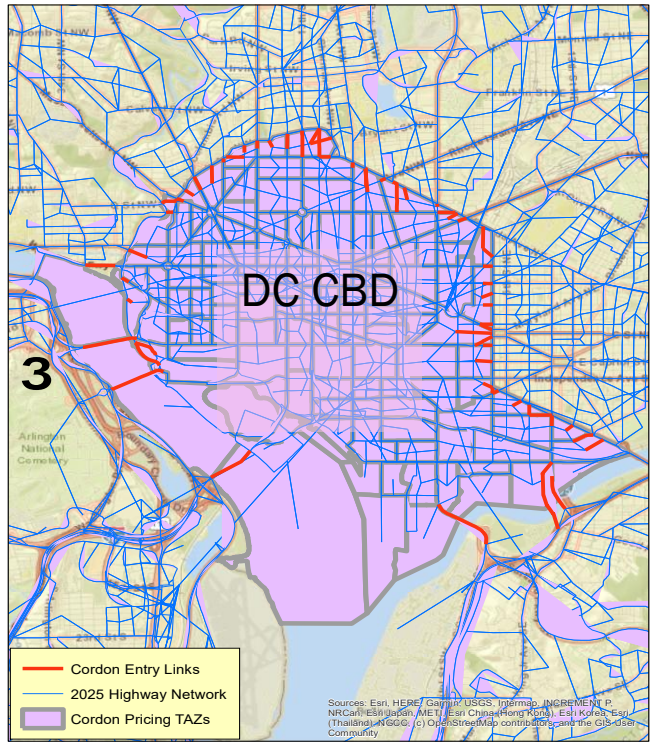
- The extended AV specification does not consider more sophisticated AV behaviors (e.g., trip chaining), network treatment or speed feedback, but it seems to provide a reasonable bookend estimation of the system impact of AV based on simplified assumptions.
- Although MWCOG staff currently does not recommend the use of the Gen3 Model for AV-related policy analysis, the Gen3 Model with this extended AV specification could be used for exploratory scenario analysis or strategic planning related to autonomous vehicles.

DC CBD Cordon Pricing

- A hypothetical scenario in which toll is charged on vehicles entering a restricted cordon zone in DC CBD.
- Finding 1: Truck/CV trips entering the cordon zone did not respond to the cordon toll, as truck/CV trip distribution model did not consider tolls. MWCOG staff fixed the issue.
- Finding 2: After the fix, the Gen2 and Gen3 model responses are comparable.







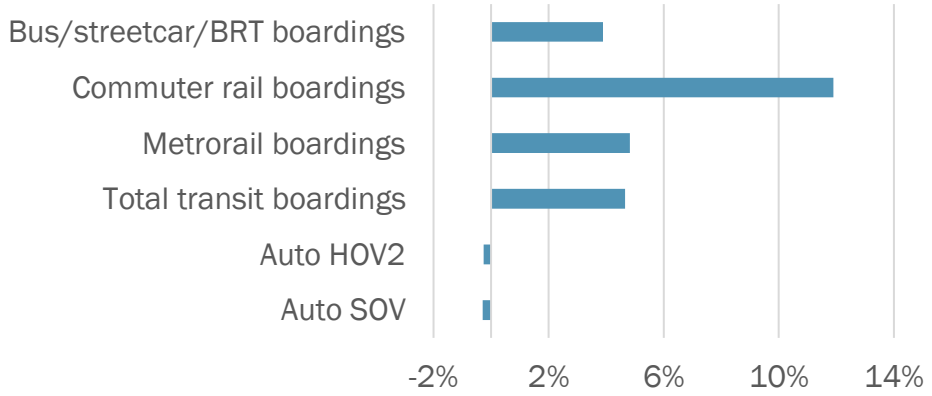
- Finding 3: Gen3 Model's disaggregate data enabled analysis of trip and population subgroups for deeper insights.

Transit Fare Subsidy

- Scenario: Increased transit subsidy availability to full-time workers in 2025.
- Finding:

Apparently, the output from the transit fare subsidy model was NOT used to condition any of the downstream models.

- The bugfix led to a much more reasonable model response.

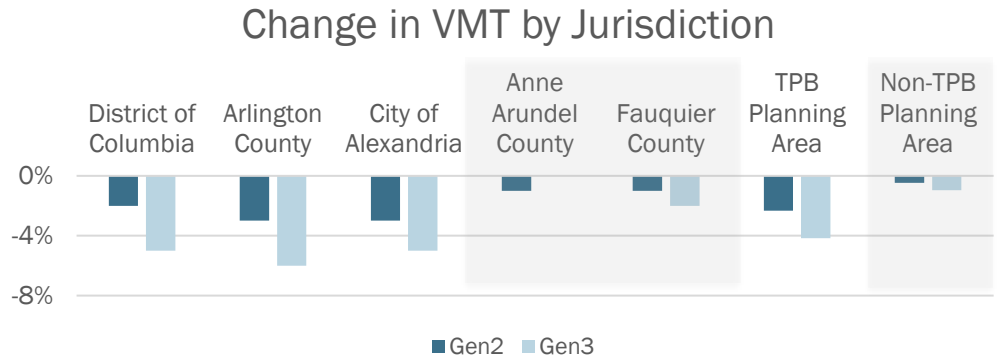


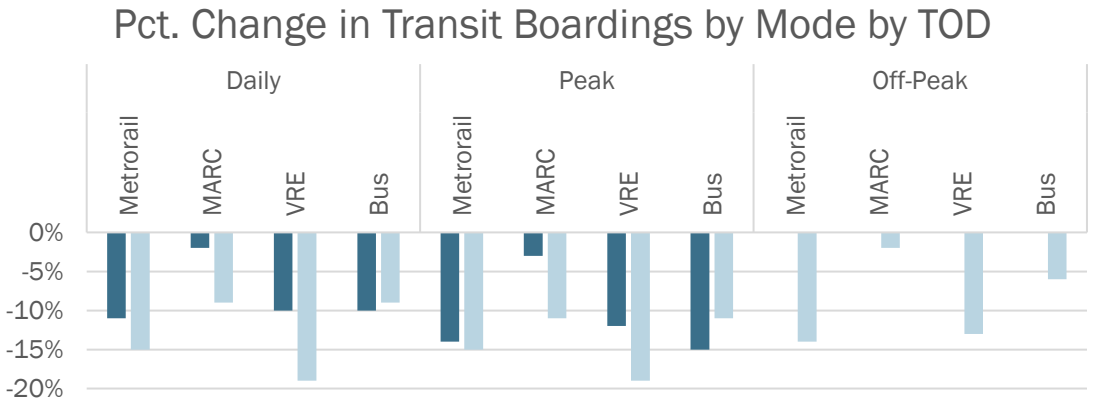
- The underrepresentation of transit subsidy indicated a need for calibrating the transit subsidy availability model to local data, and a subsequent re-calibration of mode choice models.

Telecommute Frequency

- Scenario: Increased telecommuting frequency among workers working in the TPB Planning Area for year-2025.
- Key difference in modeling methodologies:
  - In the Gen2 Model, telecommuting is not explicitly simulated, so adjustments are subjectively applied to the trip tables or trip rate parameters based on accounting assumptions.
  - The Gen3 Model offers an advantage by using an explicit behavioral model that directly simulates how often people telecommute, capturing shifts from work to discretionary activities.

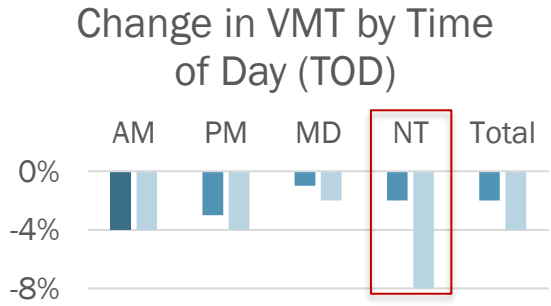
Telecommute Frequency (Cont.)





- The responses of both models were reasonable and in line with each other, with Gen3 Model generally being more sensitive to the changes in the alternative scenario.

- The model may have over-scheduled certain discretionary activities (e.g., dining out, shopping) for telecommuting workers during typical work hours, even though these activities would more likely occur in the evening.



Conclusions and Next Steps

- At the aggregate level, the responses of both the Gen2 Model and the Gen3 Model were reasonable and in line with each other, with the Gen3 Model generally being more sensitive in the scenario analyses.
- At the disaggregate level, the Gen3 Model provides more in-depth insights on travel behaviors, especially for sub-markets such as AV or telecommuting. However, the validity of those disaggregate data should be carefully examined before they can be used to support decision making.
- Next steps:
  - Release a beta version of the Gen3 Model in fall of 2025.
  - Continue to make updates to the Gen3 Model.
  - Spring 2026: Possible date to declare that the Gen3 Model is ready for production work.

Acknowledgement

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