COG/TPB GEN3 TRAVEL MODEL

Status report

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Travel Forecasting Subcommittee
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Transportation Planning Board

Overview

- Status of Gen3 Model, Phase 3, development, which is led by TPB staff with on-call support from RSG and Baseline Mobility Group (BMG):
  - Model enhancements and bug fixes (status update)
  - **Preliminary** 2025 modeling results from usability testing (status update)
    - Introduction
    - Demographic statistics
    - Aggregate-level demand statistics
      - Resident travel
      - Exogenous travel
    - Aggregate-level supply (assignment) statistics
      - Highway assignment
      - Transit assignment
- Next Steps

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Model Enhancements and Bug Fixes

- Version update (Ver. 1.0.3) to Gen3 Model:

  - Fixes to two bugs found during usability testing, one regarding the missing of HOV trips in the IX/XI trip tables, the other related to a minor rounding issue in the AreaType.s file.

  - Replacement of Mambaforge with Miniforge3.

  - Other minor model updates, such as removal of redundant model files.

- Testing of the newly released ActivitySim software (Ver. 1.3.1)

  - RSG's 10/29 test showed that Ver. 1.3.1 (without Sharrow) was 37 minutes faster than Ver. 1.2.1 for a 100% MWCOG population sample.

  - COG is considering resuming the implementation of Sharrow in Gen3 Model with ActivitySim 1.3.1, as other agencies, such as ARC and SEMCOG, recently reported significant performance improvements with Sharrow.

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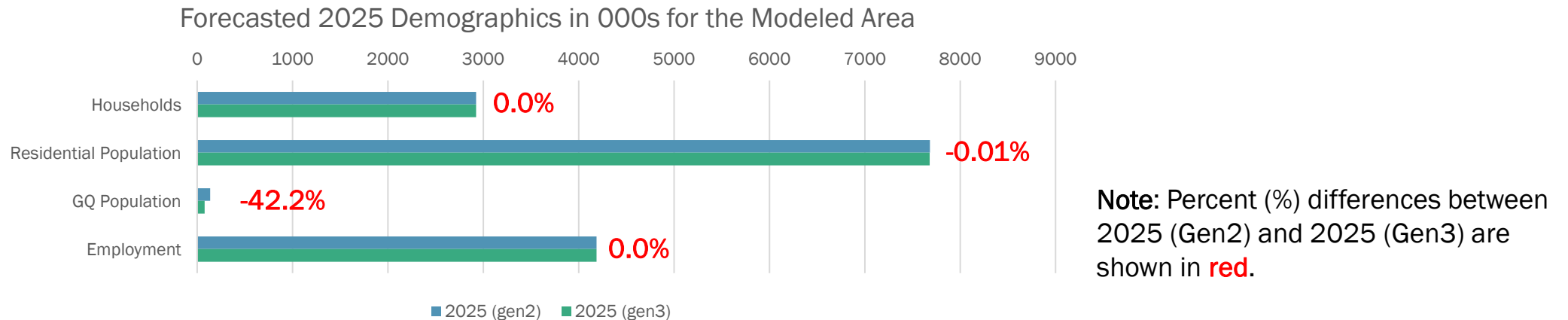**Transportation Planning Board**

Usability Testing - Introduction

- The analysis presented today compares the 2025 model run conducted for Visualize 2050 using Gen2/Ver. 2.4.6 Model and that conducted for the usability testing using Gen3/Ver. 1.0.3 Model, herein referred to as 2025 (Gen2) and 2025 (Gen3) for simplicity. Both models are currently in DRAFT, and their outputs should NOT be taken as final.

- Although 2025 (Gen2) and 2025 (Gen3) employed markedly different travel forecasting methodologies, their outputs were generated based on **largely consistent inputs**, which allowed us to draw an apples-to-apples comparison.

	2025 (Gen2)	2025 (Gen3)
Model	FSM, 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 update, but in different formats (Cube TRNBUILD vs PT)	
Transit fare inputs	Aggregated transit fare zone matrix	PT fare specifications by operator
Land use inputs	Round 10.0 Cooperative Forecasts LU data	Synthetic population generated using Rnd. 10.0 LU and census data as controls

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Usability Testing – Demographic Statistics

Forecasted 2025 Demographics in 000s for the Modeled Area

Note: Percent (%) differences between 2025 (Gen2) and 2025 (Gen3) are shown in red.

- Households: 0.0%
- Residential Population: -0.01%
- GQ Population: -42.2%
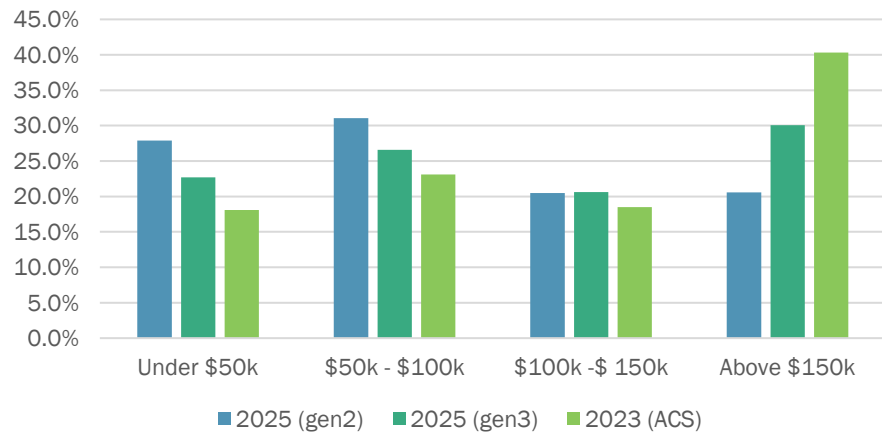- Employment: 0.0%

Legend: ■ 2025 (gen2) ■ 2025 (gen3)

- Numbers of resident households are identical in 2025 (Gen2) and 2025 (Gen3), as the population synthesizer for the Gen3 Model used zonal household data from Round 10.0 Cooperative Forecasts of LU as the primary control.

- Resident population slightly differs, as the population synthesizer used the zonal population data from Round 10.0 LU as the secondary control.

- The difference in GQ population can be attributed to the exclusion of institutional GQ population (hospital inpatients, prisoners, etc.) in 2025 (Gen3).

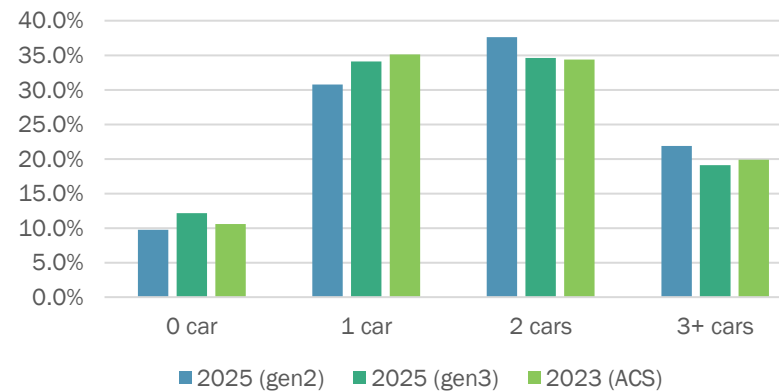- Employment data are identical as they both came from the Round 10.0 LU Forecasts.

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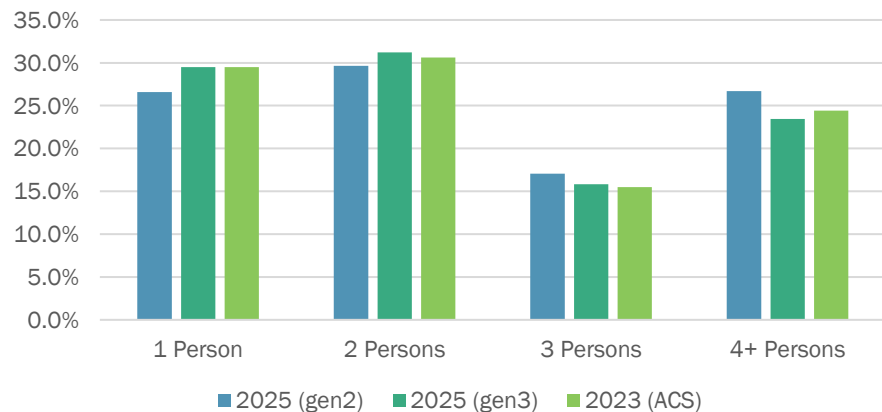
Usability Testing – Demographic Statistics

Distribution of Households by Income

Legend: 2025 (gen2), 2025 (gen3), 2023 (ACS)

Distribution of Households by Car Ownership

Legend: 2025 (gen2), 2025 (gen3), 2023 (ACS)

Distribution of Households by Size

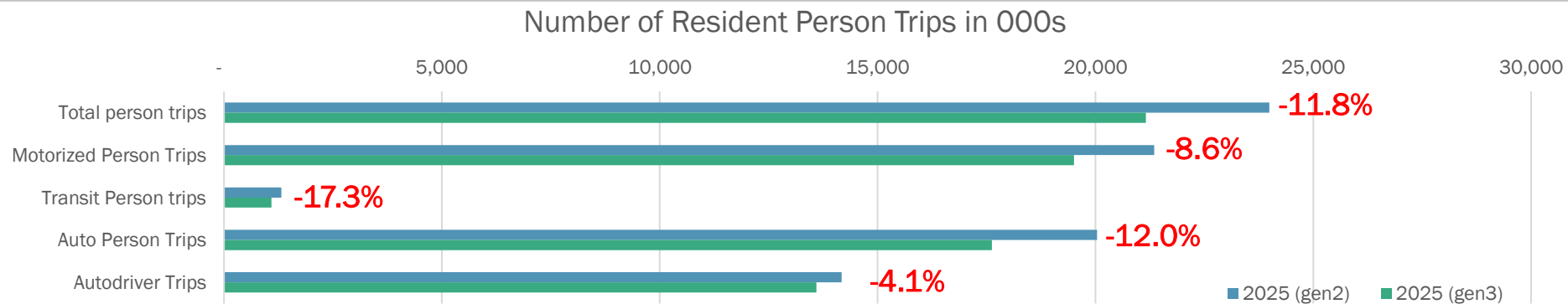Legend: 2025 (gen2), 2025 (gen3), 2023 (ACS)

Source:
- 2025 (Gen2): Gen2 Demographic Sub-models that were calibrated to 2007 HTS/ACS (modeled area).
- 2025 (Gen3): Gen3 synthetic population or car ownership model developed based on 2018 HTS/ACS (modeled area).
- 2023 (ACS): 2023 ACS 1-year report (MSA).

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Usability Testing – Resident Travel Demand

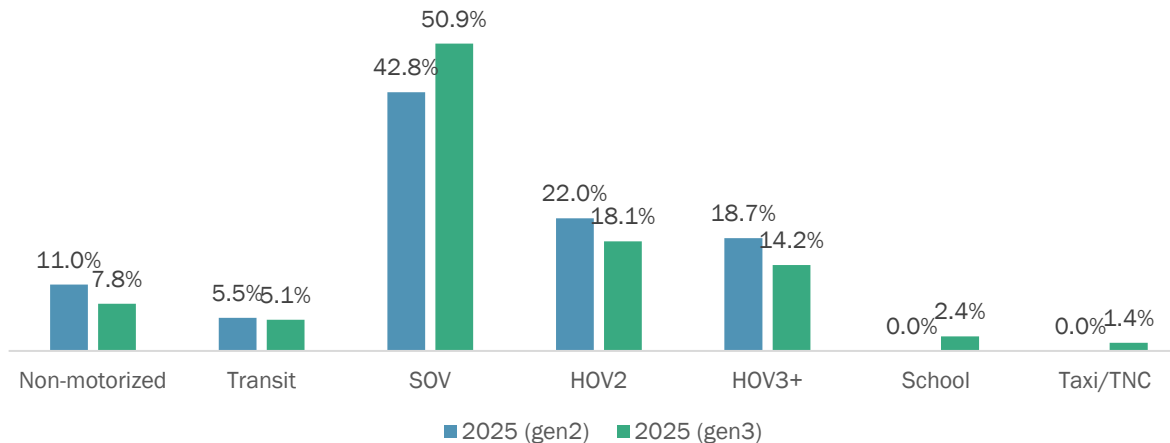Number of Resident Person Trips in 000s

- 2025 (Gen3) simulated 11.8% fewer total person trips and 8.6% fewer motorized person trips than 2025 (Gen2). The cause was two-fold:
  - Household trip rates declined in the past years according to the HTS data (from 8.7 in 2007 to 8.0 in 2018), which is consistent with a national trend.
  - Gen3 Model simulated a lower household trip rate (7.1) in 2018 as compared to the survey data (8.0) to better match VMT.
- 2025 (Gen3) simulated 17.3% fewer transit trips, which better captured the downward trend of regional transit ridership in recent years, even prior to the Covid-19 pandemic.
- 2025 (Gen3) simulated 12% fewer auto person trips but only 4.1% fewer auto-driver trips, indicating a lower auto occupancy rate (see next slide).
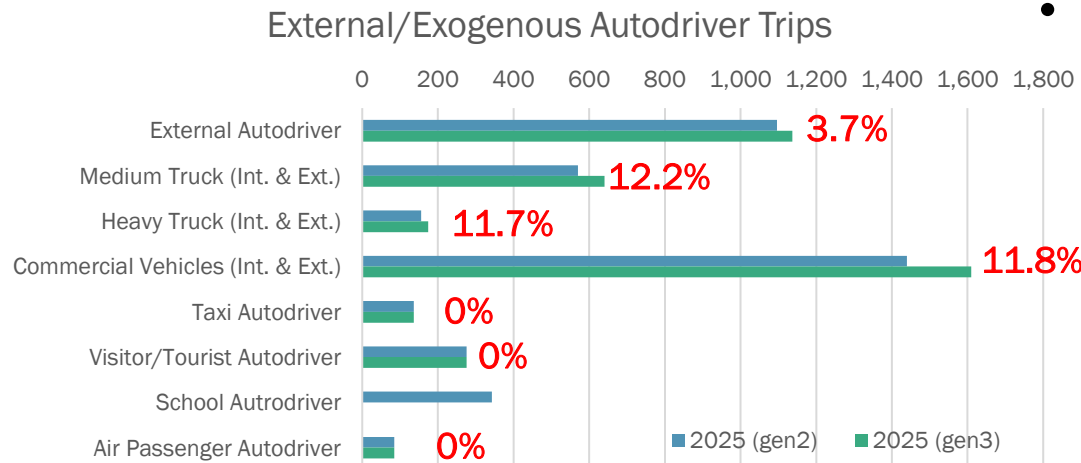
Usability Testing – Resident Travel Demand

Distribution of Resident Person Trips by Mode

	2025 (gen2)	2025 (gen3)
Non-motorized	11.0%	7.8%
Transit	5.5%	5.1%
SOV	42.8%	50.9%
HOV2	22.0%	18.1%
HOV3+	18.7%	14.2%
School	0.0%	2.4%
Taxi/TNC	0.0%	1.4%

- 2025 (Gen2) simulates non-motorized trip ends in trip generation, while 2025 (Gen3) simulates walk/bike trips in trip mode choice which was calibrated in a more rigorous manner.
- 2025 (Gen2) does not simulate school, taxi or TNC trips in resident travel (some of them are simulated as exogenous trips).

- Relative to 2025 (Gen2), 2025 (Gen3) simulated a larger share of SOV trips and a smaller share of HOV trips, leading to a smaller average auto occupancy (1.41 vs. 1.30). The cause was also two-fold:
  - Declining auto occupancy in the HTS data (from 1.39 in 2007 to 1.35 in 2018)
  - Over-simulation of SOV trips and underestimation of auto occupancy (1.30) out of Gen3 trip mode choice model base-year calibration

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Usability Testing – Exogenous Travel

External/Exogenous Autodriver Trips

- External auto-driver trips:
  - 2025 (Gen2) and 2025 (Gen3) used the same controls developed from an extrapolation of external traffic counts.
  - Different methodologies led to slightly different results: 2025 (Gen2) used a doubly constrained model for person trips; 2025 (Gen3) used a singly constrained model for auto-driver trips.

- Truck/CV trips:
  - Used the same external and internal truck/CV trip models. But Gen3 Model increases internal truck/CV trip ends by 15% to account for the rapid development of e-commerce.
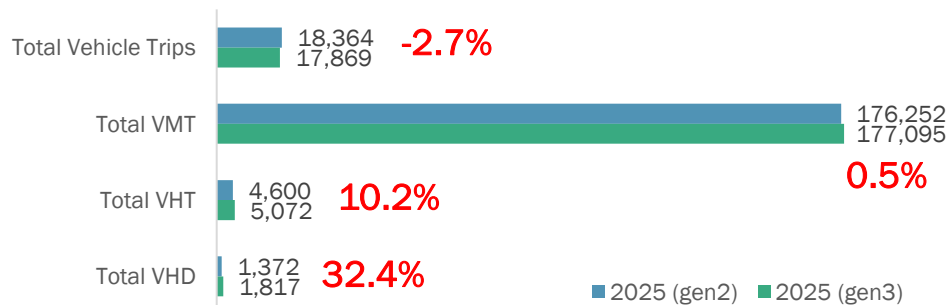 - As a result, total truck/CV trips increased by about 12% in 2025 (Gen3).
- Miscellaneous trips:
  - 2025 (Gen2) and 2025 (Gen3) used the same misc. trip inputs, except that school trips are simulated as resident travel rather than exogenous travel in Gen3 Model.
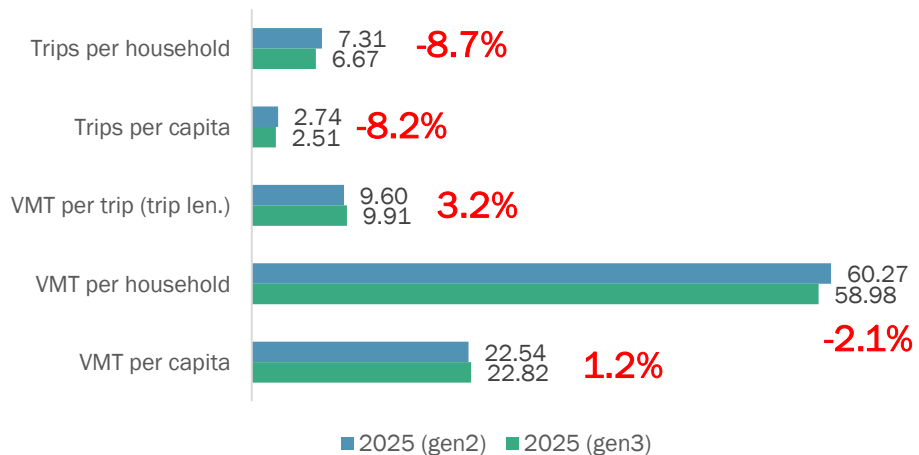
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Usability Testing – Highway Assignment

Regional Assignment Statistics: Totals in 000s

	2025 (gen2)	2025 (gen3)	% diff
Total Vehicle Trips	18,364	17,869	-2.7%
Total VMT	176,252	177,095	0.5%
Total VHT	4,600	5,072	10.2%
Total VHD	1,372	1,817	32.4%

■ 2025 (gen2) ■ 2025 (gen3)

Regional Assignment Statistics: Rates

|	2025 (gen2)	2025 (gen3)	% diff
Trips per household	7.31	6.67	-8.7%
Trips per capita	2.74	2.51	-8.2%
VMT per trip (trip len.)	9.60	9.91	3.2%
VMT per household	60.27	58.98	-2.1%
VMT per capita	22.54	22.82	1.2%

■ 2025 (gen2) ■ 2025 (gen3)

- Relatively small difference in total vehicle trips assigned, as 2025 (Gen3) simulated fewer auto-driver trips in resident travel but more in exogenous travel.
- Marginal difference in total VMT, as both models closely validated to the 2018 HPMS VMT data.
- More significant differences in VHT and VHD can be explained by shifts in trip time-of-day (TOD) distributions (see next slide).
- Trip rates dropped in 2025 (Gen3), which is consistent with the observed trend in the HTS data.
- VMT per trip (average trip length) slightly increased in 2025 (Gen3).
- Due to increased trip length, there was a smaller % decrease in VMT per household and a slight increase in VMT per capita.

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Usability Testing – Highway Assignment

Simulated/Observed Distributions of Vehicle Trips by Time of Day

Legend: ■ 2025 (gen2) ■ 2025 (gen3) ■ 2007 (2007/08 HTS) ■ 2018 (2017/18 RTS)
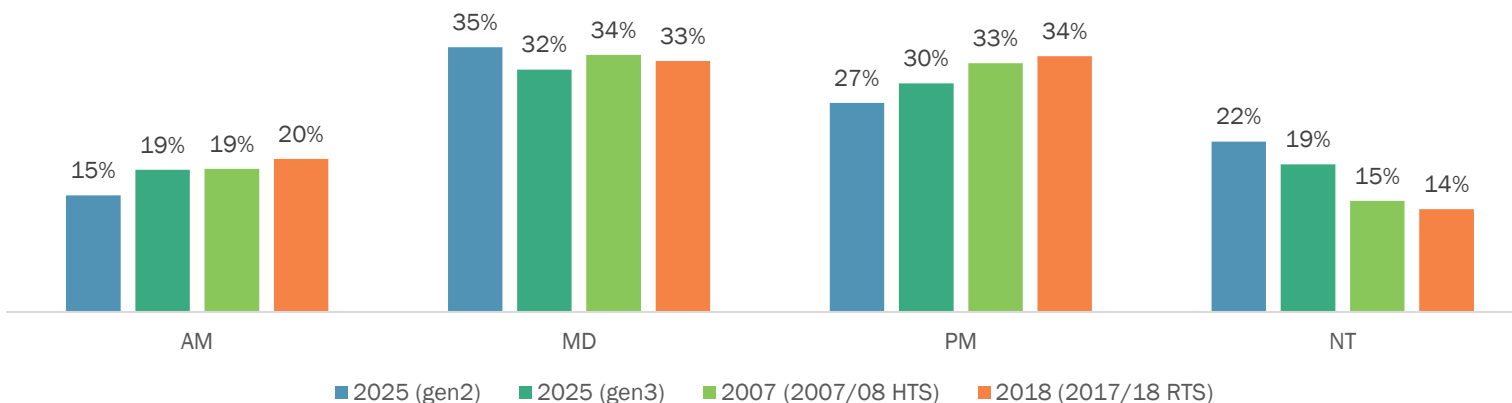
- 2025 (Gen2), using time-of-day splits extracted from 2007/08 HTS, significantly underestimated the AM/PM shares of vehicle trips compared to observed data.

- 2025 (Gen3) used a more refined, disaggregate trip TOD choice model that was calibrated to 2017/18 RTS data. The resulting trip TOD distribution more closely matched observed data.

- Due to the exponential form of volume delay function, increase in traffic in AM/PM peak periods between 2025 (Gen2) and 2025 (Gen3) led to dramatic increases in VHD.

- Despite the general decrease in VMT in off-peak periods, traffic volume increases on a small group of "hotspot" links led to overall VHD increase in off-peak periods as well.

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Usability Testing – Highway Assignment
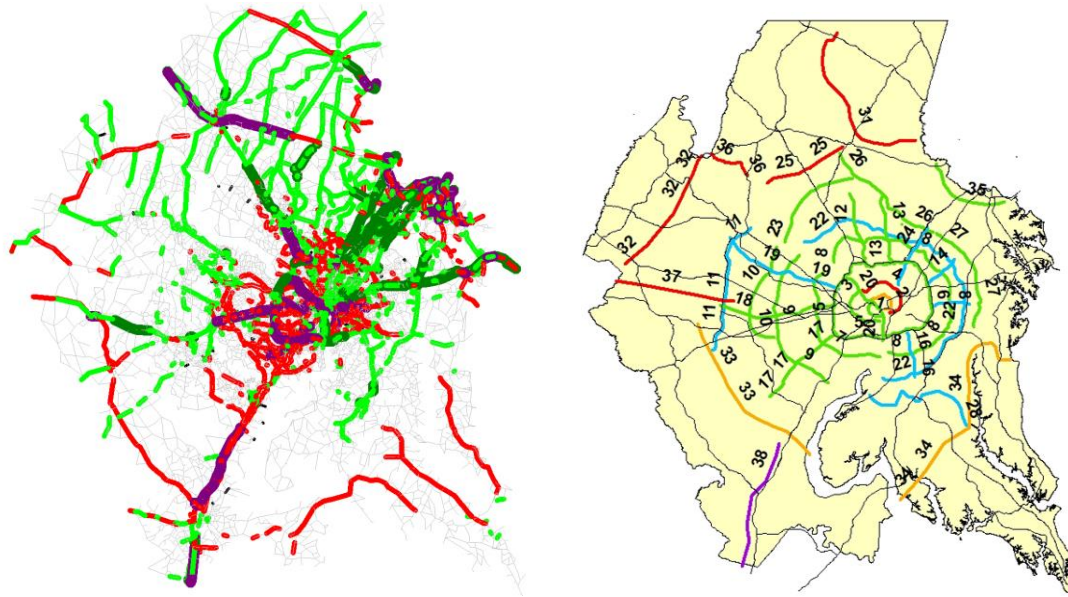
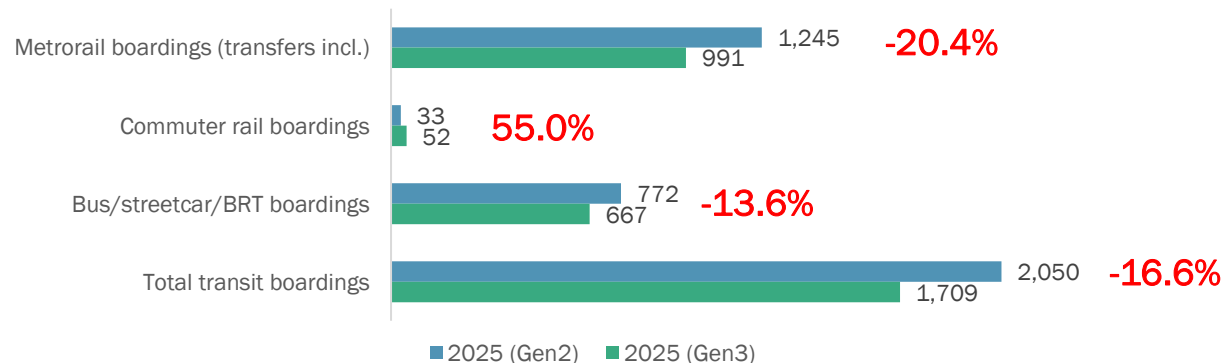% Diff. in Traffic Volumes by Screenline: 2025 (Gen3) minus 2025 (Gen2)
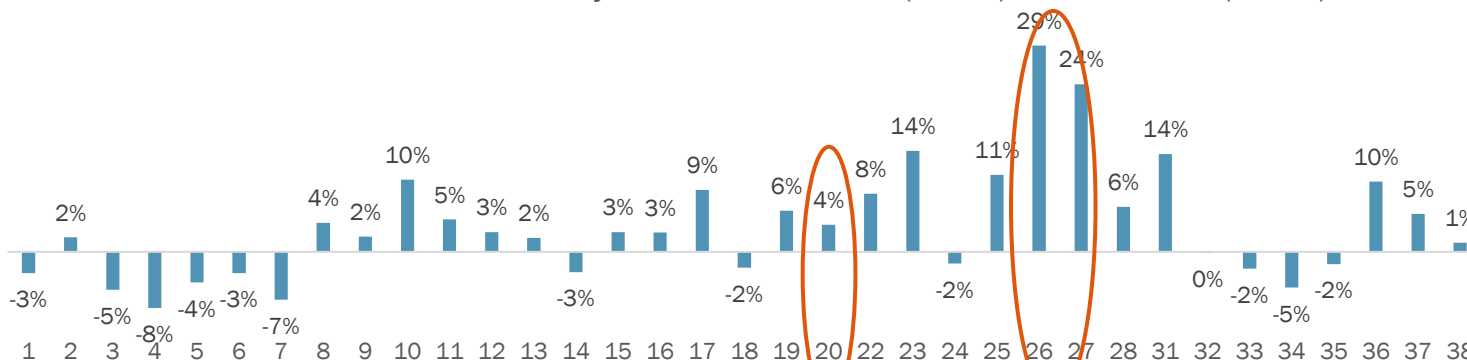
- At the link level (see the plot on the left), the dispersed differences in traffic volumes between 2025 (Gen2) and 2025 (Gen3) can largely be attributed to the different O-D travel patterns that the two models were calibrated to. Other factors, such as differences in external traffic, may have also contributed to volume differences in localized areas.

- At the screenline level, differences in traffic volumes were all within +/- 15% except for #26 and #27. The difference on the critical Potomac River crossing screenline (#20) was marginal.

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Usability Testing – Transit Assignment

Simulated transit boardings (in 000s) by mode

Mode	2025 (Gen2)	2025 (Gen3)	% change
Metrorail boardings (transfers incl.)	1,245	991	-20.4%
Commuter rail boardings	33	52	55.0%
Bus/streetcar/BRT boardings	772	667	-13.6%
Total transit boardings	2,050	1,709	-16.6%

■ 2025 (Gen2)   ■ 2025 (Gen3)

- Not an apples-to-apples comparison: P/A format (Gen2) vs. O/D format (Gen3).
- Overall, 2025 (Gen3) simulated 16.6% fewer transit boardings in this region, mainly because Gen3 Model was calibrated to the 2018 transit ridership data.
- 2025 (Gen3) simulated 55% more commuter rail boardings for the following reasons:
  - Gen3 Model was closely calibrated and validated to the 2018 data, while Gen2 Model under-simulated commuter rail ridership in 2018.
  - Gen3 Model assigned external transit trips, which constituted a significant portion of the commuter rail ridership, while Gen2 Model did not.

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Next Steps

- COG staff will continue to review the 2025 preliminary results for Gen3 Model usability testing, especially at the sub-regional level.

- Using 2025 (Gen2) and 2025 (Gen3) as the baseline, COG staff will conduct additional sensitivity tests/scenario tests as part of the usability testing.

- COG staff will prepare 2030 model inputs and conduct the 2030 model for usability testing.

- RSG staff will revisit model calibration to tighten up the calibration of trip mode choice model and time-of-day choice model in the Gen3 Model.

- COG staff, with consultant assistance, will continue to test Cube 2024 and ActivitySim 1.3.1.

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Acknowledgement

- Special thanks to the project team:

  - COG: Ray Ngo, Meseret Seifu, Bahar Shahverdi, Jim Yin, Wanda Owens, Jane Posey, Mark Moran, Dusan Vuksan, Nazneen, and others.

  - RSG/BMG: Andrew Rohne, Joel Freedman, and Mushtaq Rahman.

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