

# TRANSITIONING TO MOVES5

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## MOVES5 VS MOVES4 - COMPARISON OF EMISSIONS ESTIMATES

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July 8, 2025



# What is MOVES?

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- MOVES, or Motor Vehicle Emissions Simulator, is a tool developed by the EPA to estimate air pollution from motor vehicles
  - This includes criteria pollutants (e.g., VOC & NO<sub>x</sub>), greenhouse gas (GHG) emissions, and air toxic emissions
- TPB is required to use MOVES to estimate nitrogen oxide (NO<sub>x</sub>) and volatile organic compound (VOC) emissions for air quality conformity (AQC) analyses, because the region is classified as nonattainment for ground-level ozone
  - VOC and NO<sub>x</sub> are ozone precursor pollutants
- Regional state air agencies are required to use MOVES emissions estimates to set the motor vehicle emissions budgets (MVEBs) in state implementation plan (SIP) activities for the attainment of air quality standards



# Why Transition to MOVES5 Now?

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- TPB staff must use the latest MOVES model (MOVES5) for upcoming 2015 Ozone National Ambient Air Quality Standards (NAAQS) SIP-related activities to be in compliance with latest federal regulations
- Specifically, TPB staff will be developing VOC and NOx inventories that will be used to set the MVEBs associated with the Maintenance Plan (MP) and Redesignation Request (RR)



# MOVES5 - Release and Deadlines

- EPA periodically updates the MOVES model to account for changes in assumptions and methodologies:
  - Minor updates: fixing minor technical issues (“bugs”)
  - Major updates: incorporating new regulations, providing additional modeling capabilities, fixing major issues
- EPA’s latest emissions model, MOVES5, was officially released in the Federal Register on December 11, 2024<sup>1</sup>
- EPA provided a 2-year grace period, which ends on December 11, 2026, before MOVES5 must be used for conformity analyses
- EPA requires immediate use of MOVES5 for new SIP development (such as the 2015 Ozone NAAQS MP/RR)

<sup>1</sup>Federal Register Vol 89, No. 238/ Wednesday December 11, 2024 “Official Release of the MOVES5 Motor Vehicle Emissions Model for SIPs and Transportation Conformity [2024-29073.pdf \(govinfo.gov\)](#)



# MOVES5 - Summary of Changes Relative to MOVES4

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- Accounts for new and changed emission rules
- Incorporates new data on light-duty and heavy-duty brake wear emissions
- Incorporates a new feature: Expanding vehicle age up to 40 years instead of 30.
- Includes updates to emission rates: Updating fuel properties for calendar year 2021 and later
- Includes updates to historical and forecast default travel activity, vehicle population, age distributions, and fuel distributions



# MOVES5 - New Regulations

## MOVES5 accounts for new regulations adopted after development of MOVES4

- **Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles (2024)<sup>2</sup>**
  - Higher projected electric vehicle (EV) fractions and more stringent standards for CO<sub>2</sub>, particulate matter (PM), NO<sub>x</sub>, and non-methane organic gases (NMOG)
  - EPA estimates that these “standards will significantly reduce emissions of greenhouse gases (GHG), hydrocarbons, nitrogen oxides (NO<sub>x</sub>), and particulate matter (PM<sub>2.5</sub>) from new passenger cars, light trucks, and larger pickups and vans”
- **Heavy-Duty Greenhouse Gas Emissions-Phase 3 Rule (2024)<sup>3</sup>**
  - Higher projected EV fractions and updated energy consumption for heavy-duty EVs
  - EPA projects that these standards “will result in significant benefits for public health and welfare through substantial reductions in CO<sub>2</sub> emissions from heavy-duty vehicles”

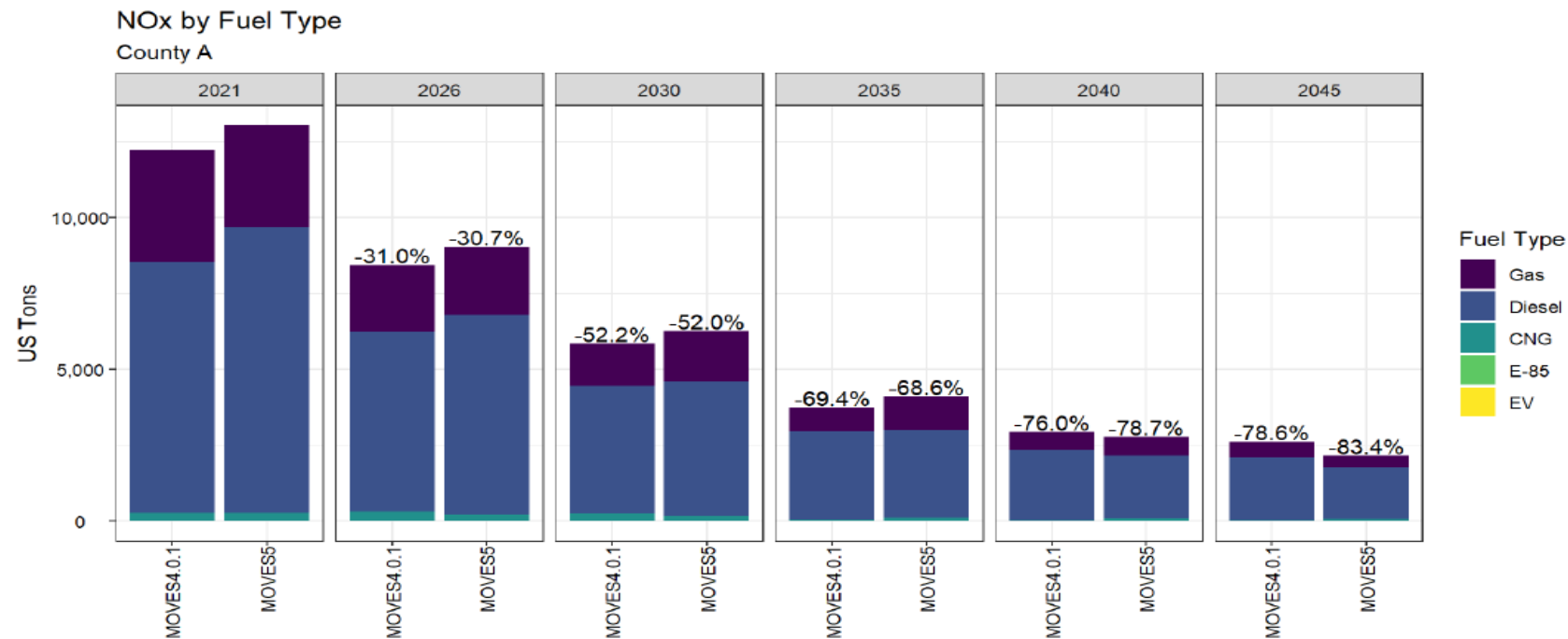
<sup>2</sup>Regulatory Announcement EPA-420-F-24-016: “Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles.” Washington, D.C.: U.S. Environmental Protection Agency. March 2024.

<sup>3</sup>Regulatory Announcement EPA-420-F-24-018: “Final Standards to Reduce Greenhouse Gas Emissions from Heavy-Duty Vehicles for Model Year 2027 and Beyond.” Washington, D.C.: U.S. Environmental Protection Agency. March 2024.



# MOVES5 – EPA Notes Possible NOx Declines

- The figure shows that “MOVES5 NOx is higher than MOVES4 until about 2040 due to changes in fleet mix and the modeling of older vehicles. After about 2040, MOVES5 NOx is lower due to more stringent LD standards and a greater fraction of EVs. Note that until about 2040, the percent reduction in emissions from 2021 is similar in the two versions.”

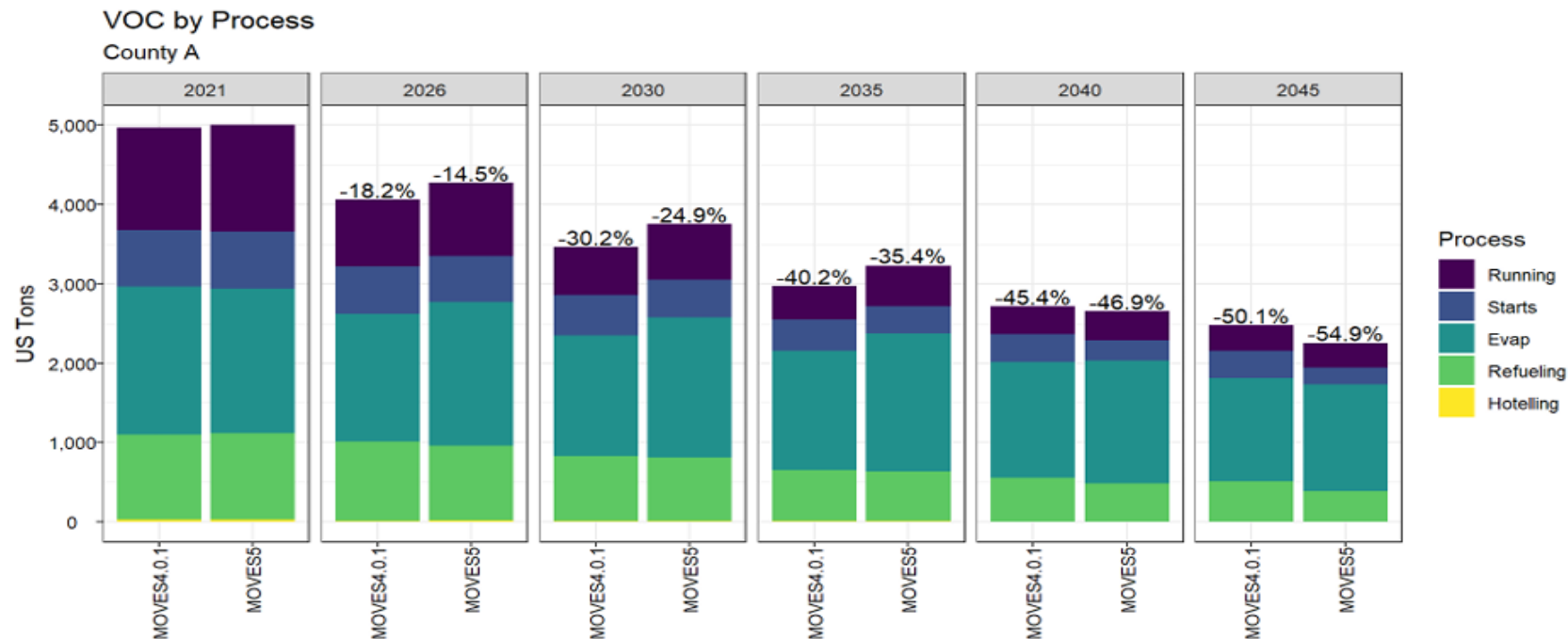


Source: Office of Transportation and Air Quality. “Overview of EPA’s Motor Vehicle Emission Simulator (MOVES5).” Washington, D.C.: U.S. Environmental Protection Agency, November 2024. <https://www.epa.gov/system/files/documents/2025-02/420r25005.pdf>



# MOVES5 – EPA Notes Possible VOC Declines

- The figure shows that “onroad VOC emissions are dominated by emissions from gasoline vehicles, which decline with the phase-in of Tier 3 standards, the increased fraction of electric vehicles, and tighter standards under the LMDV rule. Like other pollutants, VOC emissions in MOVES5 are higher than MOVES4 until about 2040 due to more detailed accounting of vehicles age 30-40 and changes in the fleet mix.”

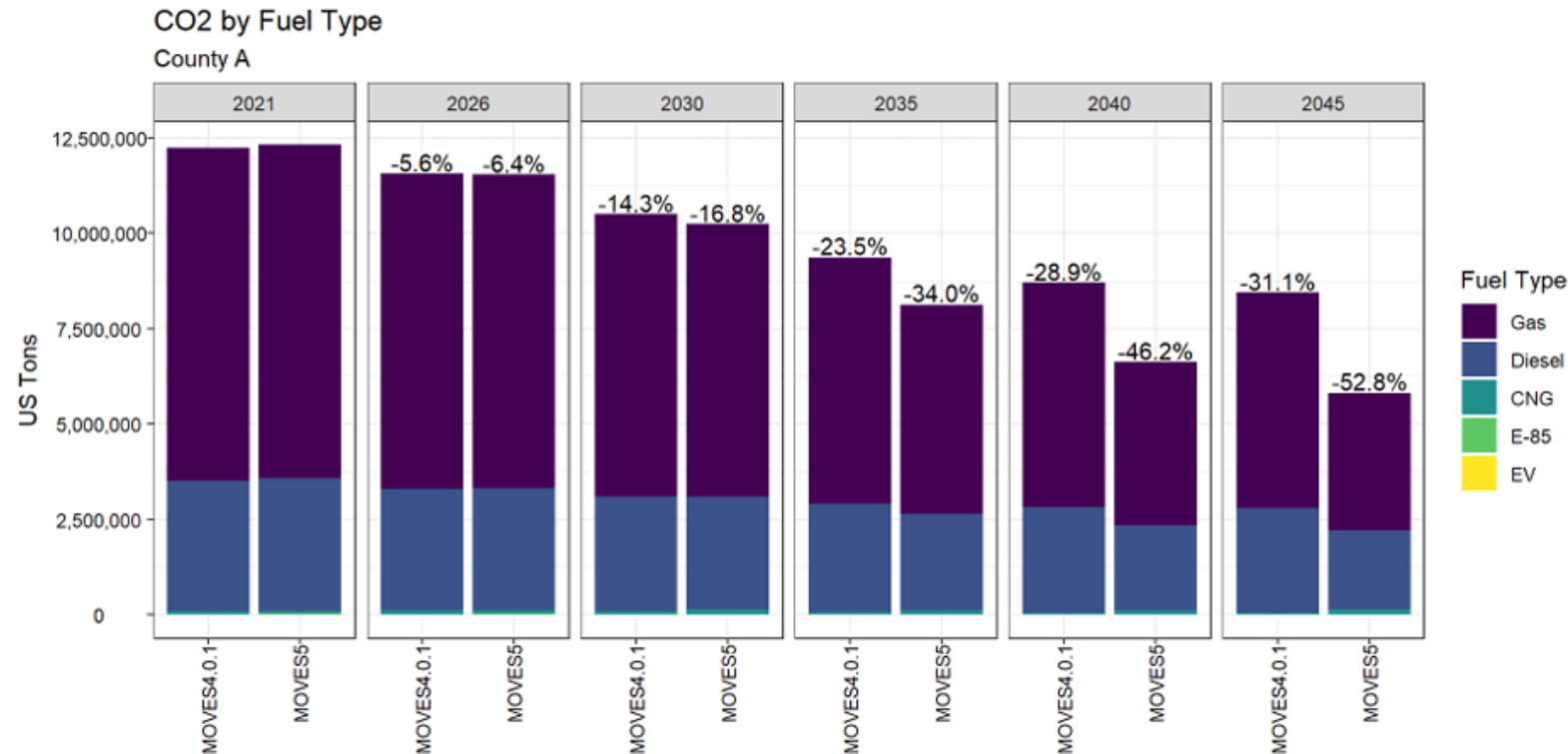


Source: Office of Transportation and Air Quality. “Overview of EPA’s Motor Vehicle Emission Simulator (MOVES5).” Washington, D.C.: U.S. Environmental Protection Agency, November 2024. <https://www.epa.gov/system/files/documents/2025-02/420r25005.pdf>



# MOVES5 – EPA Notes Possible GHG Declines

- “While total VMT is quite similar in both models, for exhaust CO<sub>2</sub>, MOVES5 projects substantially greater decreases over time than MOVES4. This reflects the shift to more EVs as well as more efficient vehicles with internal combustion engines.”



Source: Office of Transportation and Air Quality. “Overview of EPA’s Motor Vehicle Emission Simulator (MOVES5).” Washington, D.C.: U.S. Environmental Protection Agency, November 2024. <https://www.epa.gov/system/files/documents/2025-02/420r25005.pdf>



# MOVES5 – Preliminary Sensitivity Tests

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- TPB staff ran sensitivity tests for MOVES5 using draft MOVES4 inputs from the Visualize 2050 and FY 2026-2029 Transportation Improvement Program (TIP) air quality conformity analysis with default Alternate Vehicle and Fuel Technology (AVFT) data
- MOVES5 and MOVES4 runs contained the same underlying data used in input development
- Summaries in this presentation show differences between two different sets of estimated/modeled data



# MOVES5 – Preliminary Sensitivity Tests

## Percent Difference MOVES5 vs MOVES4: NO<sub>x</sub> (short tons/day)

Year	MOVES4	MOVES5	MOVES5 versus MOVES4
2025	45.894	45.926	0.1%
2026	41.809	42.110	0.7%
2030	27.910	28.511	2.2%
2040*	13.963	13.891	-0.5%
2045*	12.518	12.046	-3.8%
2050*	12.111	11.417	-5.7%

\* Visualize 2050 option with the I-495 Southside Express Lanes Study is assumed.



# MOVES5 – Preliminary Sensitivity Tests

## Percent Difference MOVES5 vs MOVES4: VOC (short tons/day)

Year	MOVES4	MOVES5	MOVES5 versus MOVES4
2025	28.457	28.721	0.9%
2026	26.372	27.027	2.5%
2030	22.211	22.802	2.7%
2040*	17.039	16.104	-5.5%
2045*	15.696	14.372	-8.4%
2050*	14.948	13.466	-9.9%

\* Visualize 2050 option with the I-495 Southside Express Lanes Study is assumed.



# MOVES5 – Preliminary Sensitivity Tests

## Percent Difference MOVES5 vs MOVES4: GHG (short tons/year)

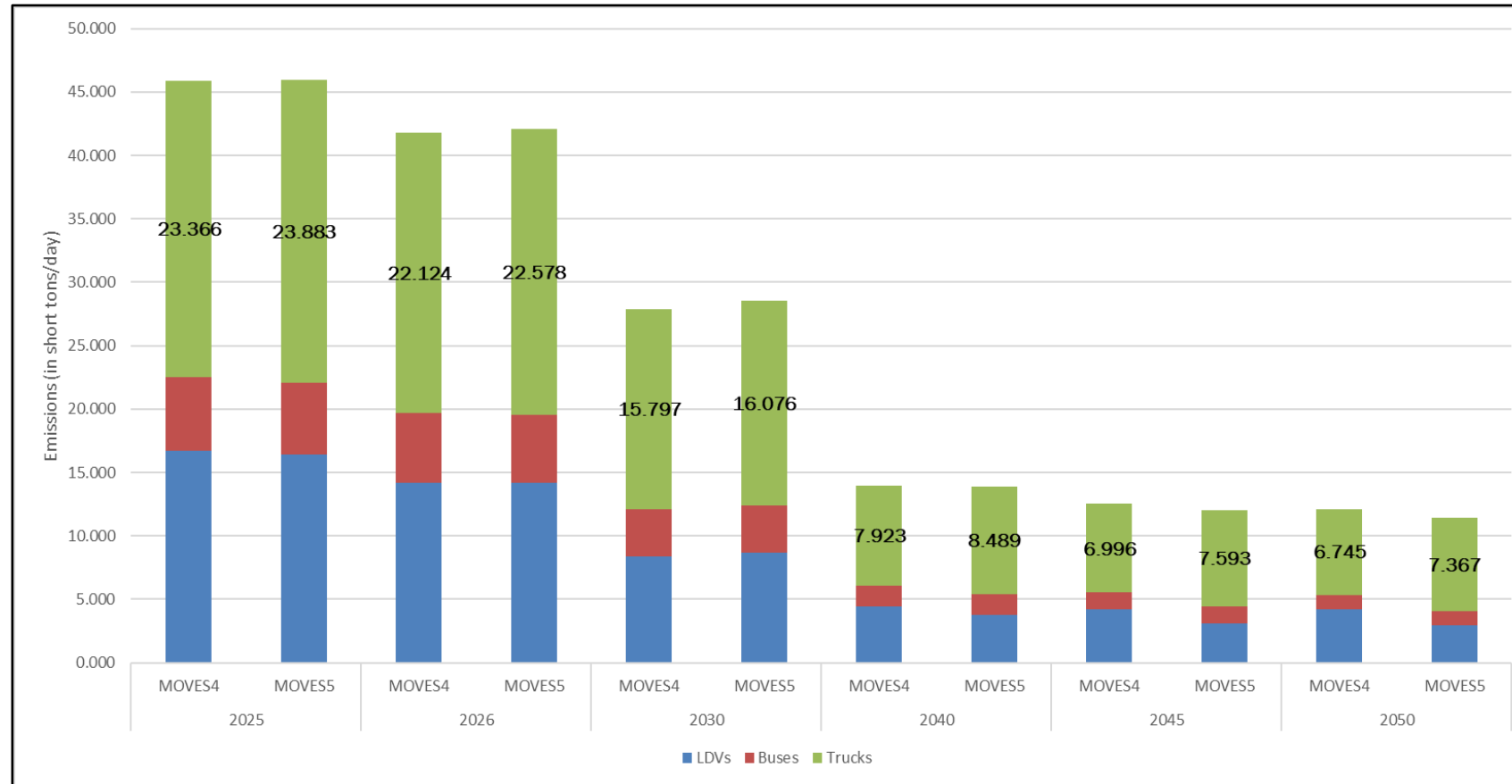
Year	MOVES4	MOVES5	MOVES5 versus MOVES4
2025	22,844,177	22,894,231	0.2%
2026	22,279,723	22,277,882	0.0%
2030	20,076,110	19,461,649	-3.1%
2040*	17,340,649	14,088,160	-18.8%
2045*	17,156,352	13,279,720	-22.6%
2050*	17,305,177	13,068,870	-24.5%

\* Visualize 2050 option with the I-495 Southside Express Lanes Study is assumed.



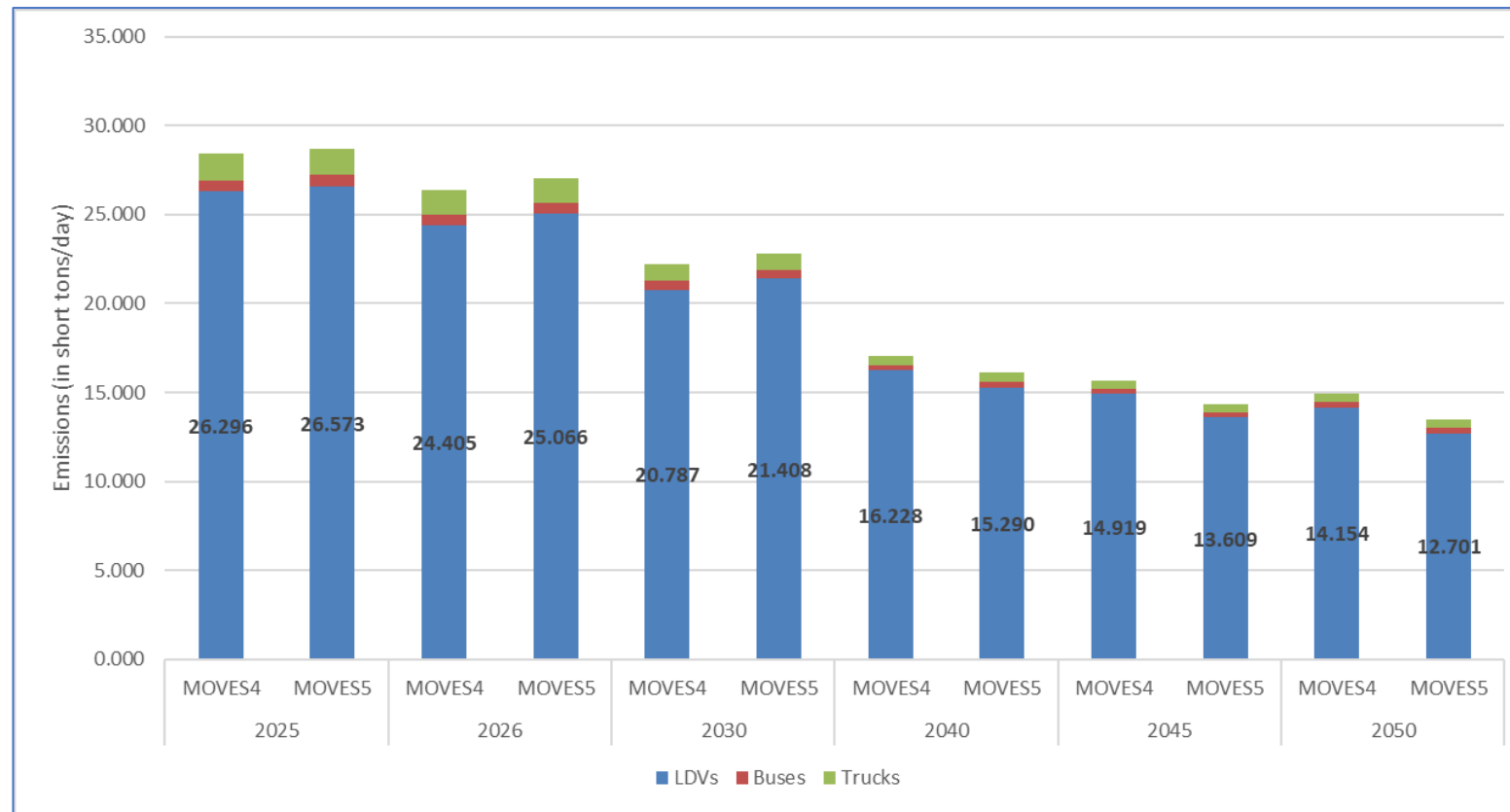
# MOVES5 – Preliminary Sensitivity Tests

Ozone NOx Emissions by Analysis Year and Vehicle Type: MOVES5 vs. MOVES4 (short tons/day);  
Draft Visualize 2050



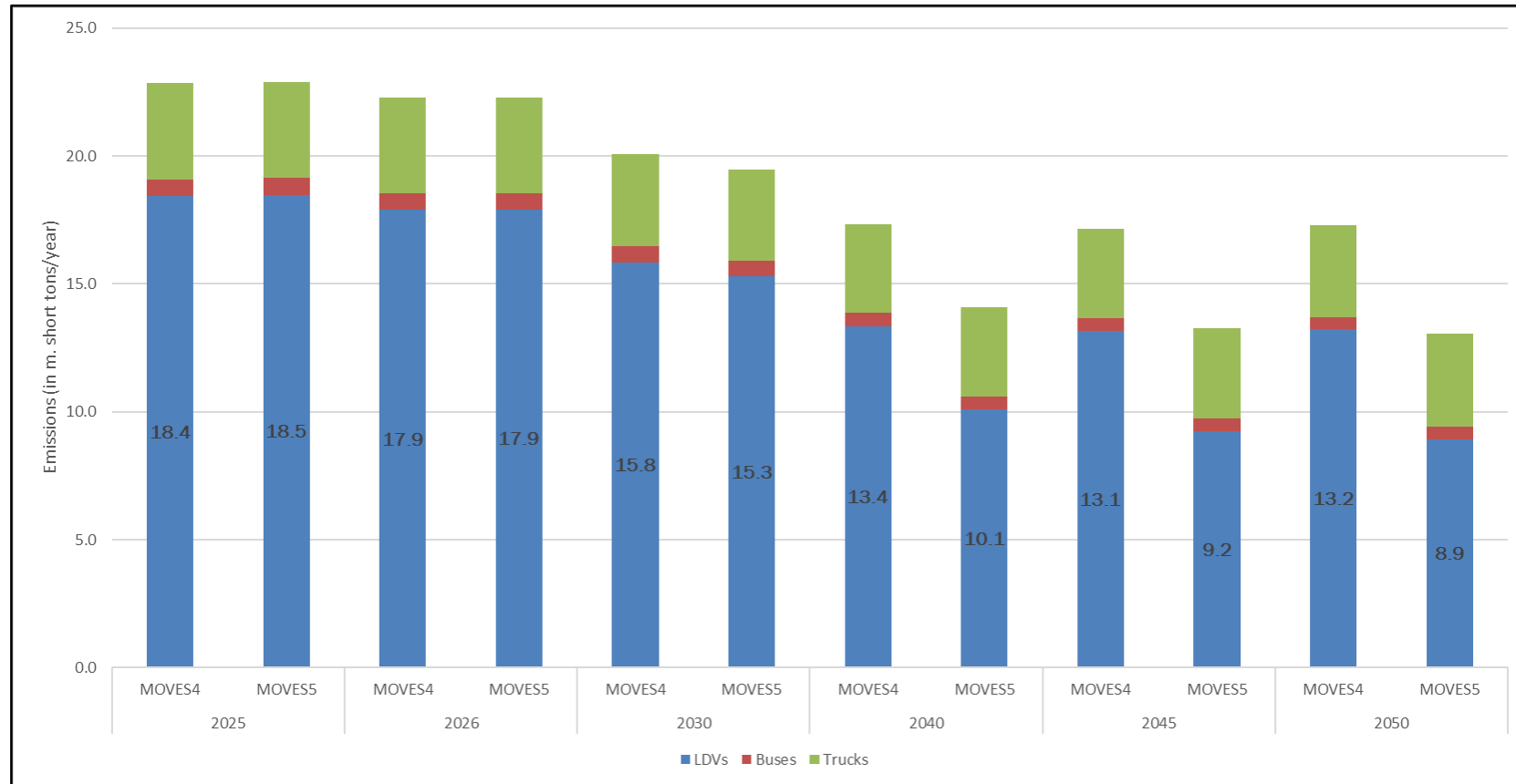
# MOVES5 – Preliminary Sensitivity Tests

Ozone VOC Emissions by Analysis Year and Vehicle Type: MOVES5 vs. MOVES4 (short tons/day);  
Draft Visualize 2050



# MOVES5 – Preliminary Sensitivity Tests

GHG Emissions by Analysis Year and Vehicle Type: MOVES5 vs. MOVES4 (million short tons/year);  
Draft Visualize 2050



# MOVES5 –COG's Sensitivity Tests Findings

- At the regional level, TPB staff's MOVES5 sensitivity testing results are in line with those reported by the EPA at the national level
- MOVES5 NOx emissions are higher than MOVES4 NOx emissions until about 2040 due to the changes in the fleet mix and the modeling of older vehicles; after 2040, MOVES5 NOx emissions are lower due to more stringent light-duty (LD) standards and a greater fraction of EVs
- VOC emissions follow a similar trend to NOx emissions; however, light-duty vehicles are the highest contributors to VOC emissions in both models
- Light-duty vehicles account for the majority of GHG decreases in MOVES5, especially in later years
- Of all analyzed pollutants, implementation of MOVES5 has the greatest impact on estimated GHG emissions, especially in later years



# MOVES Resources

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- Want to learn more about MOVES?

<https://www.epa.gov/moves>



# Next Steps:

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- MOVES5 will be used in emissions modeling and MVEB setting associated with the 2015 Ozone NAAQS SIP activities (MP and RR) in FY 2026
- TPB staff will continue to monitor regulatory developments and assess potential impacts of any new regulations on future emissions estimates and the region's ability to conform to the NAAQS for criteria pollutants



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