ITEM 10 – Information
September 22, 2021

TPB Climate Change Mitigation Study

Background: The TPB Climate Change Mitigation Study of 2021 (CCMS) is a 12-month scenario study whose goal is to identify potential pathways for the region to reduce on-road, transportation-sector greenhouse gas emissions to meet regional greenhouse gas (GHG) reduction goals associated with 2030 and 2050. The consultant, ICF, presented findings from its literature review on June 4 to the Technical Committee. In July, the literature review was finalized and shared with both the Technical Committee and the TPB (as part of the Director's Report). The consultant recently finished a technical memo, dated August 25, that lists the scenarios to be analyzed for the study. This memo was shared with the Technical Committee on August 27 via email and was presented at the September 10 Technical Committee meeting. The last presentation to the TPB regarding this study was made by Erin Morrow on May 19. The study is expected to be completed in December.

Climate Change Mitigation Study of 2021 – Scenario Development

National Capital Region Transportation Planning Board

Michael Grant
ICF

September 22, 2021

Key Goals of Study

Identify pathways to achieve 2030 and 2050 greenhouse gas reduction goals, focusing solely on surface transportation

Explore future scenarios to understand what types of strategies (policies, programs, and investments) are needed to achieve the goals, and what level of GHG reductions might be achieved under different scenarios

Key Analysis Steps

Review of past studies	Conduct review of climate change mitigation studies in the COG region (Phase I, performed by TPB staff)
Literature review	Conduct Phase II literature review of climate change mitigation studies and climate action plans
List of scenarios and actions	Develop a limited list of scenarios and associated GHG reduction actions to explore
Tool/model selection	Select tools/models for the analysis
Analysis	Calibrate and validate the selected tools and models; conduct analysis using the selected tools
Report	Document and present findings in a draft and final report

Literature Review

What are regional agencies and utilities doing to reduce transportation sector GHG emissions?

How have other cities and states across the world achieved GHG reductions? Or plan to achieve reductions?

What is known about transportation strategies and their effectiveness?

Pathways to GHG Reduction

Mode Shift and Travel Behavior (MSTB)

- Mode shifts to transit, carpooling, nonmotorized
- Reduce trip lengths (e.g., brings jobs and housing closer together)
- Replace trips (e.g., telework, alternative work schedules)

Transportation Systems Management and Operations (TSMO)

- Enhance incident management, traffic signal coordination, and other operations strategies
- Reduce speeding and idling
- “Eco-driving”

Vehicle Technology and Fuels

- Improve fuel economy of vehicle fleet
- Advance alternative fuels
- Accelerate electric vehicle deployment

Vehicle Travel Activity (vehicle miles traveled) x Energy efficiency (BTU/mile) x Carbon intensity (gCO_2e/BTU) = Total GHG emissions (gCO_2e)

Review of Transportation Strategies – General Findings

Vehicle Technology and Fuel Strategies

- Large potential for GHG reduction
  - Estimated 73-76% GHG reduction per vehicle in region by shifting to battery electric vehicle
  - Decarbonization of electric grid increases benefits further
  - A national study estimated 15% GHG reduction from baseline forecast in 2030 and 94% reduction in 2050 with shifts to EV sales and cleaner grid
  - Constraints relate primarily to rate of vehicle turnover

Mode Shift and Travel Behavior Strategies

- Meaningful but not deep GHG reductions likely
  - Studies generally show 4-24% reduction compared to 2050 baseline forecast under aggressive assumptions
  - Many analyses focus on reducing VMT per capita, but not overall VMT at a regional scale
  - Largest effects generally are from pricing strategies, such as VMT fees (which apply to all travel); land use strategies may have large effects depending on level of development growth; generally small effects from transit, bicycle/pedestrian, and other investments, although there can be synergistic effects

Transportation Systems Management and Operations Strategies

- Modest GHG reductions due to smoother traffic flow and less idling
  - Studies generally suggest up to a few percent reduction in GHGs at a regional scale
  - Most studies are based on conventional vehicles; benefits decline as fleet transitions to hybrids/EVs

Other Important Issues from Literature Review

Carbon Pricing Strategies

- May be in the form of carbon taxes or cap-and-trade/invest programs
- Create economic incentives both on travel behavior and vehicle fleet/fuel decisions
- Yield notable short and long-term effects, depending on level of pricing

Electric Utility-Focused Strategies

- Electric grid plays a larger role in transportation GHG emissions as more vehicles shift to EVs
- The power sector is moving toward more electricity generation from zero carbon sources

Co-benefits and Equity Considerations

- Many strategies have co-benefits in terms of cost savings, mobility and accessibility, safety, and public health improvements
- Equity is an important consideration: Some strategies like road pricing, carbon pricing, telework, and incentives for new vehicle purchases can raise equity concerns, but policies often can be designed to address these issues

Top-Down Analysis

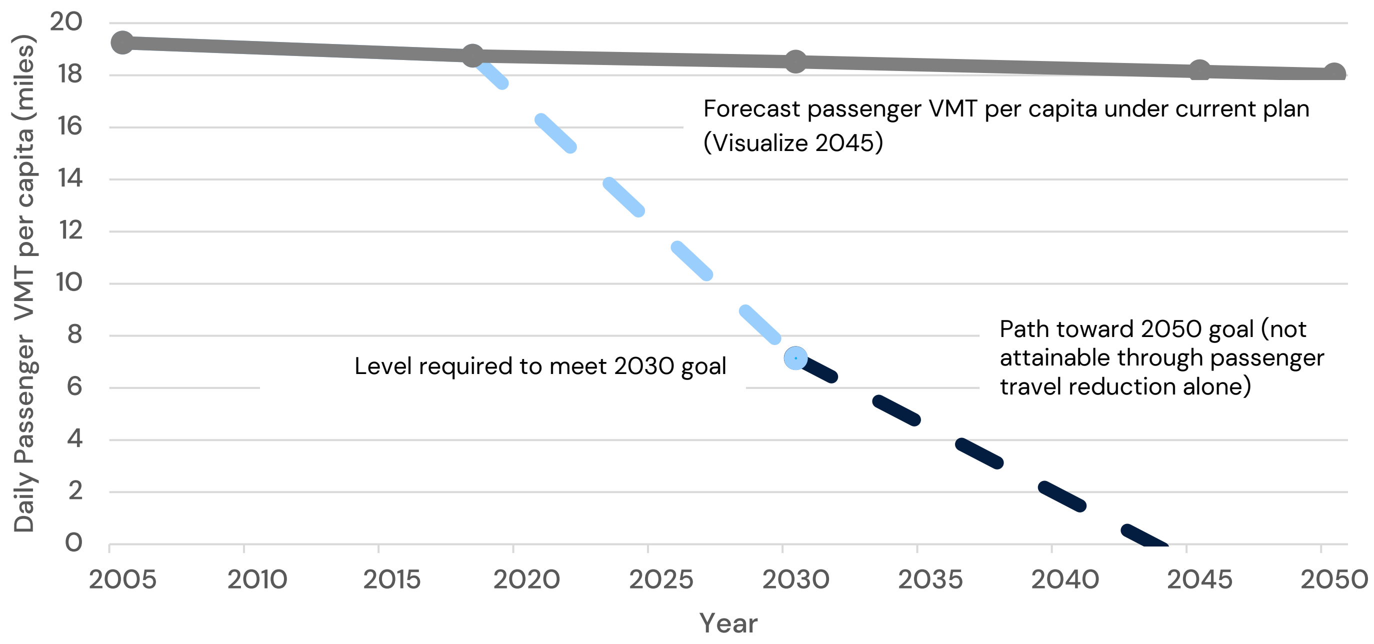
What level of VMT reduction would be needed to meet the 2030 and 2050 goals?

What level of technology adoption would be needed to meet the 2030 and 2050 goals?

VMT Reduction Alone

- To achieve 50% emissions reduction goal by 2030 (compared to 2005 levels), passenger VMT
  - Would need to drop by 57% from 2018 level (61% compared to the 2030 forecast level)
  - Would need to drop from 18.74 daily vehicle-miles per capita in 2018 to 7.13 in 2030.
- 80% emissions reductions goal by 2050
  - Is not attainable through passenger VMT reduction alone
  - Medium and heavy-duty vehicle emissions exceed the 2050 goal of 4.15 million metric tons by 2.24 million metric tons.

Daily Passenger VMT per Capita Required to Meet GHG Goals through VMT Reduction Alone

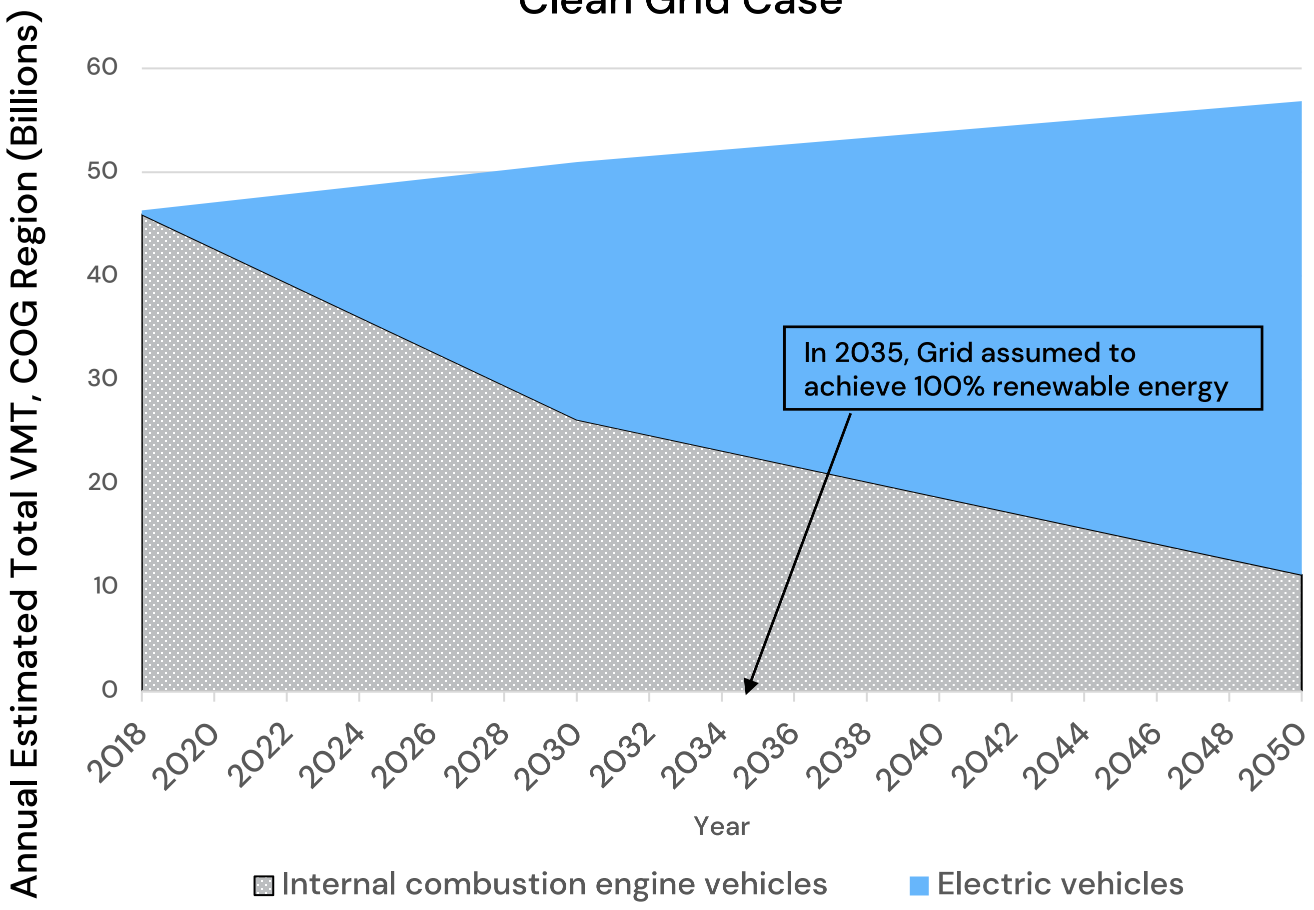


These are unprecedented levels of sustained VMT reduction that would likely require very high levels of pricing (road, parking, fuel), nearly complete telework, and/or restrictions on driving.
Despite forecasted population growth, traffic volumes in the region would need to shrink to the level seen at the height of the COVID-19 stay-at-home orders during April 2020 and not rebound.

Vehicle Technology Alone

- To achieve the 50% emissions reduction goal by 2030:
  - 75% of vehicles on the road would need to be EVs by 2030 using the ICF Reference Case ("on the books policies") for electricity carbon intensity
  - 48% would need to be EVs by 2030 in the Clean Grid Case
- 80% emissions reduction goal by 2050:
  - Cannot be achieved under the ICF Reference Case assumptions for electricity carbon intensity
  - 79% of vehicles on the road would need to be EVs by 2050 in the Clean Grid Case

Forecast VMT by Technology Type Required to Meet GHG Goals through Shifts to EVs Alone
Clean Grid Case



The required level of fleet change by 2030 is extremely ambitious and would likely require immediate shifts to all new vehicles sold as EVs, aggressive incentives to accelerate vehicle turnover, and/or carbon or fuel pricing increases.

Note: This "top down" analysis used simplified assumptions with proportionate EV adoption across all vehicle classes; more robust analysis using different assumptions about EV adoption by different vehicle classes will be conducted as part of the scenario analysis.

Scenarios for Analysis

Overview of 10 Scenarios

Pathway	Scenario	Title
Vehicle Technology and Fuels Improvements	VT.1	Vehicle Technology and Fuels Improvement Scenario
	VT.2	Amplified Vehicle Technology and Fuels Improvement Scenario
Mode Shift and Travel Behavior	MS.1	Mode Shift Scenario
	MS.2	Amplified Mode Shift Scenario
	MS.3	Amplified Mode Shift Scenario + Road Pricing
Transportation Systems Management and Operations (TSMO)	TSMO	Transportation Systems Management and Operations Improvement Scenario
Combined Pathways	COMBO.1	Combined Scenario (VT.1 + MS.1 + TSMO)
	COMBO.2	Combined Scenario with More Aggressive Technology Emphasis (VT.2 + MS.1 + TSMO)
	COMBO.3	Combined Scenario with More Aggressive Mode Shift Emphasis (VT.1 + MS.3 + TSMO)
	COMBO.4	Combined Scenario with Aggressive Actions Across All Pathways and Shared Connected and Automated Vehicle (CAV) Future (VT.2 + MS.3 + TSMO + shared CAV assumptions)

Vehicle Technology and Fuels Improvements Scenarios

Vehicle Technology and Fuels Improvement Scenarios		
Strategies	VT.1 Scenario	VT.2 Scenario
Light-duty passenger car and truck sales shifting to EVs	50% of new sales are EVs in 2030, ramping up to 100% in 2040	100% of new sales are EVs by 2030, with increased fleet turnover
Medium-and-heavy-duty truck sales shifting to EVs	30% of new sales are EVs in 2030, ramping up to 100% in 2050	50% of new sales are EVs in 2030, ramping up to 100% in 2040
Transit and school bus fleet conversion	50% of buses on the road are EVs in 2030, 100% in 2050	100% of buses on the road are EVs by 2030
Biodiesel and renewable diesel	Modest reduction in carbon intensity of diesel, consistent with low-carbon fuel standard	More substantial reduction in carbon intensity of diesel, consistent with more aggressive low-carbon fuel standard, mandates, potentially supported by carbon pricing

Mode Shift and Travel Behavior Scenarios

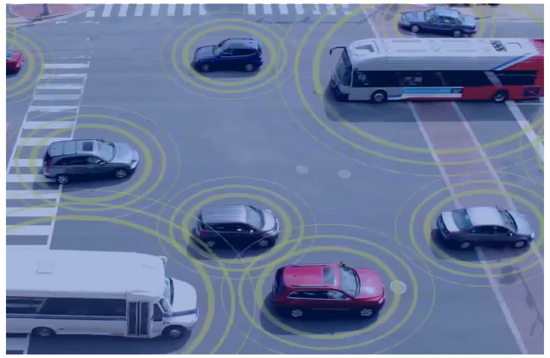
Mode Shift and Travel Behavior Scenarios			
Strategies	MS.1 Scenario	MS.2 Scenario	MS.3 Scenario
Land use changes and bicycle/ pedestrian/ micromobility enhancements	Shifts incremental growth outside of Activity Centers after 2025 to Activity Centers and areas with high-capacity transit stations; adds additional households to the region to improve jobs-housing balance	Same as MS.1, with additional shifts to bicycle/pedestrian modes	Same as MS.2
Reduce transit fare	Transit fares reduced 50% by 2030 and 75% by 2050	Free transit	Same as MS.2
Telework	25% telework assumption on an average day (about 50% telework for “office” workers)	40% telework assumption on an average day (about 80% telework for “office” workers)	Same as MS.2
Workplace Parking	All workplace parking in Activity Centers is priced by 2030	All workplace parking in Activity Centers is priced by 2030, and priced in all locations by 2050	Same as MS.2
Reduce transit travel times	Reduction of transit travel times of 10% by 2030 and 20% by 2050	Reduction of transit travel times of 15% by 2030 and 30% by 2050	Same as MS.2
Road pricing	None	None	VMT fees of $0.05 per mile in 2030 and $0.10 per mile in 2050; Cordon pricing of $5 per motor vehicle trip in DC by 2030 and beyond

Transportation Systems Management and Operations (TSMO) Scenario

Transportation Systems Management and Operations Scenario	
Strategies	TSMO Scenario
Ramp metering, incident management, active signal control, and active transportation demand management, and eco-driving	Extensive deployment regionwide to optimize traffic flow for 2030 Plus assumed eco-driving efficiencies from connected and automated vehicles (CAVs) by 2050

Combined Scenarios

Scenario	Scenario Assumptions
COMBO.1: All Pathways	VT.1 + MS.1 + TSMO
COMBO.2: More Aggressive Technology Emphasis	VT.2 + MS.1 + TSMO
COMBO.3: More Aggressive Mode Shift Emphasis	VT.1 + MS.3 + TSMO
COMBO.4: Most Aggressive Across All Pathways with Shared CAV Future	VT.2 + MS.3 + TSMO + Shared CAVs



Electricity Grid Sensitivity Analysis

- Emissions from EVs depend on the emissions profiles of electricity generation
- ICF will perform a sensitivity analysis using three emissions cases:

Reference Case

- Based on current **on-the-books** policies in VA, DC, and MD

Modified Reference Case

- Slightly more aggressive than Reference Case, assuming zero-carbon grid by 2040 in MD

Clean Grid Case

- Most aggressive, assumes 100% clean grid by 2035

Tools and Models for Analysis

Tools and Models for Use in Analysis

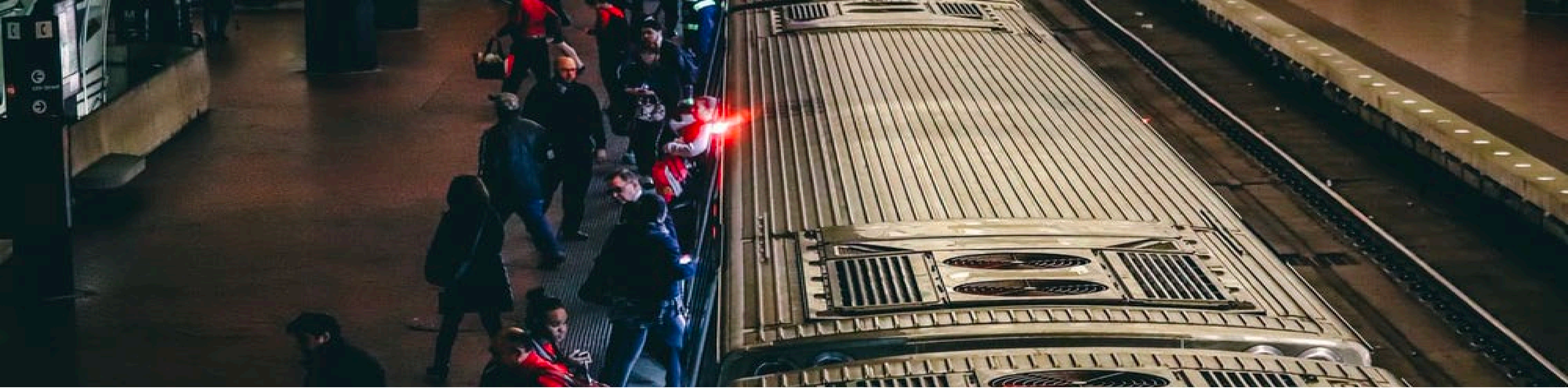
Sketch planning tools and models selected to analyze individual strategies and combinations

- For vehicle technology and fuels strategies, use of fleet analysis tools (VISION) along with sketch analysis
- For MSTB strategies, use of TRIMMS analysis tool, combined with limited analysis using the regional travel demand model
- For TSMO strategies, apply adjustments to emissions rates based on literature review and scale based on congestion

Spreadsheet-based model developed for study to analyze effects of scenarios

Sensitivity analysis to be conducted using electric power carbon intensity

- Building on Integrated Planning Model (IPM)



Implications / Next Steps

- Robust set of 10 scenarios being analyzed
- Will explore estimated impacts to determine those scenarios that could achieve the 2030 and 2050 goals, and where scenarios fall short
- Will highlight policy issues, including equity considerations associated with strategies

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