Climate Change Mitigation Study of 2021 – Scenario Development

TPB Technical Committee - Agenda Item 6

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ICF

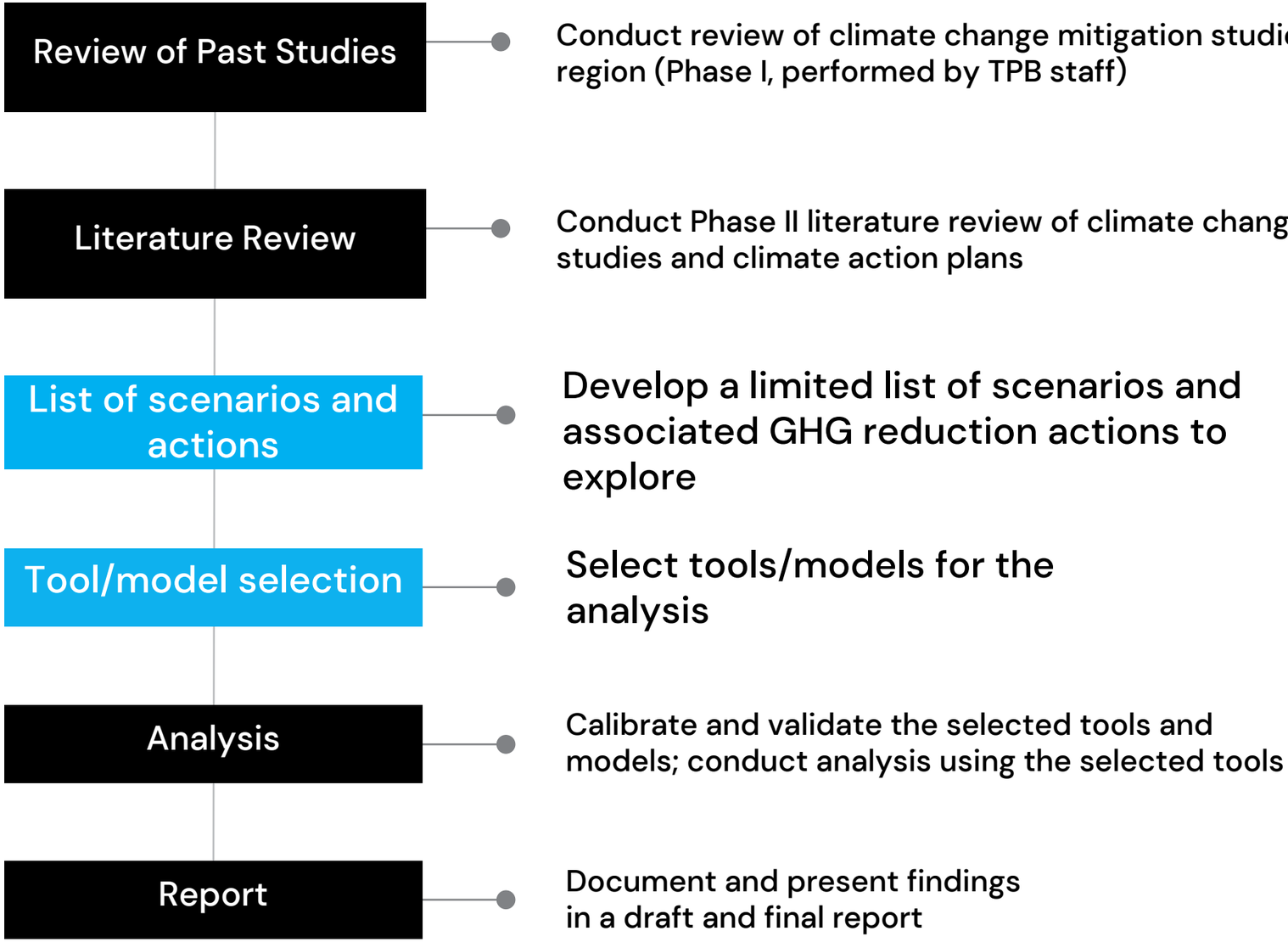
September 10, 2021

Key Goals of Study

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

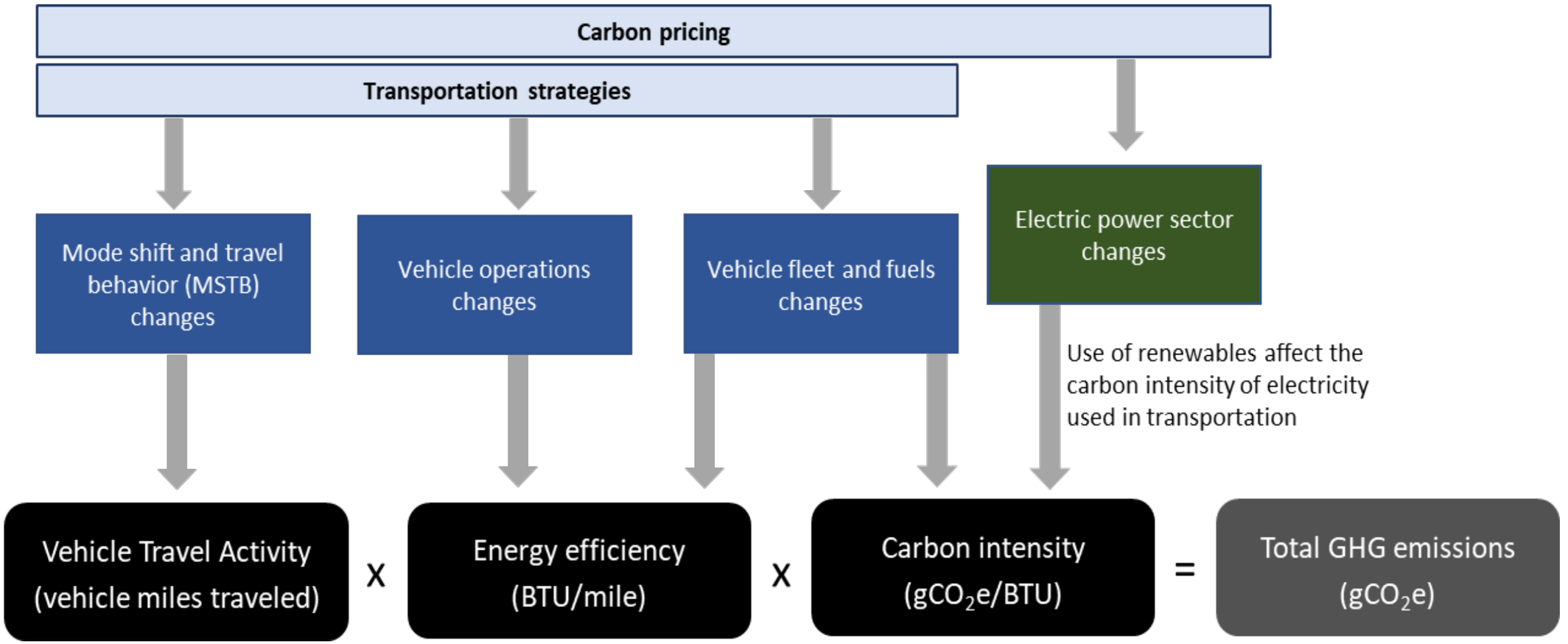
Explore future scenarios to understand what types of strategies (policies, programs, and investments) are needed to achieve the goals, and what level of GHG reductions might be achieved under different scenarios

Key Analysis Steps



Pathways for Reducing Transportation GHG Emissions

Pathways for reducing GHG Emissions



Top-Down Analysis

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

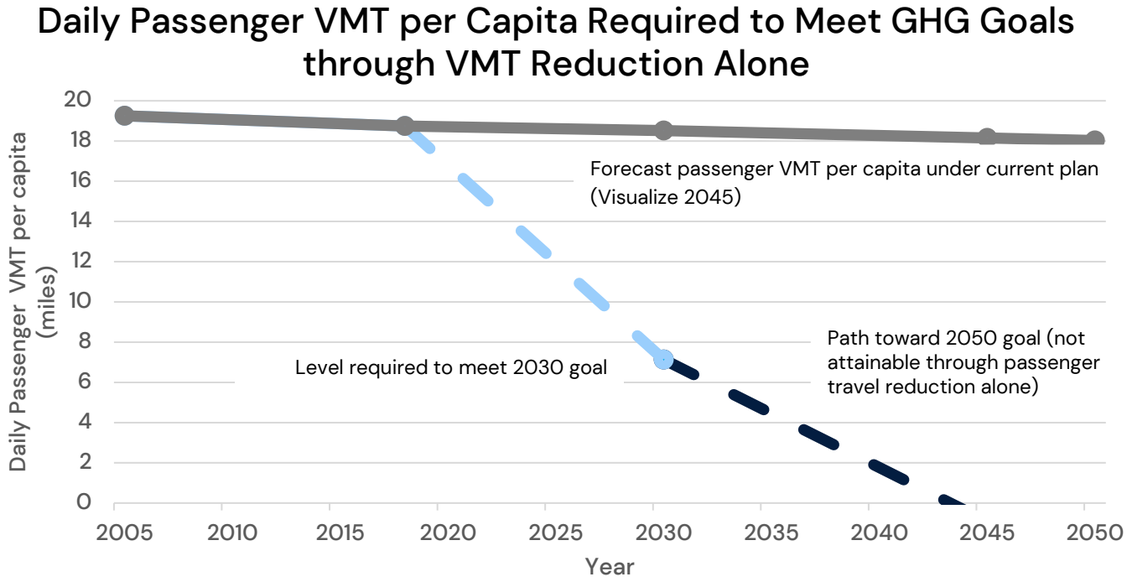
What level of technology adoption would be needed to meet the 2030 and 2050 goals?

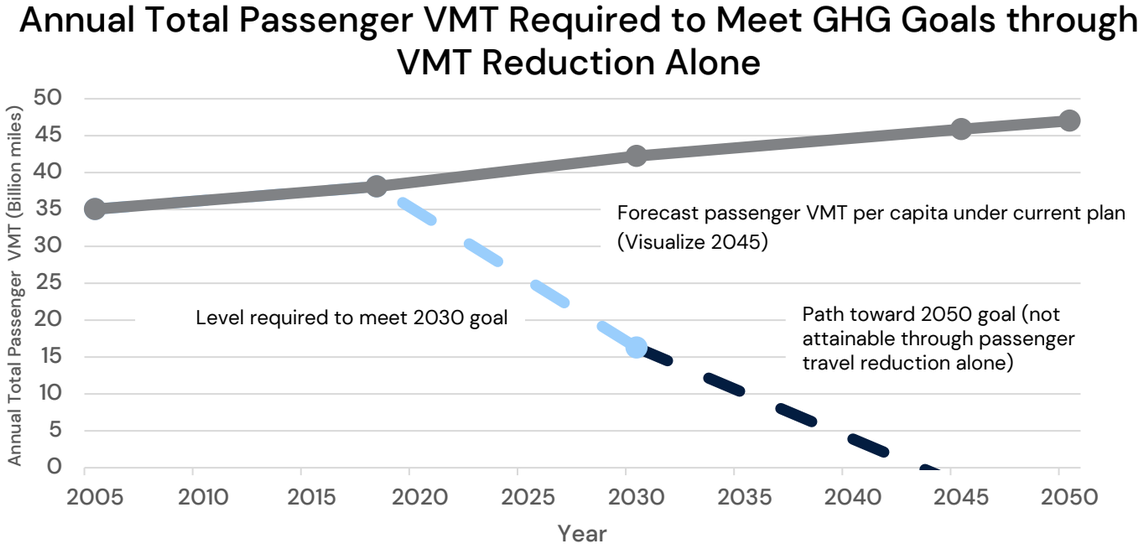
Could Transportation Systems Management & Operation (TSMO) strategies alone meet the 2030 and 2050 goals?

VMT Reduction Alone

- To achieve 50% emissions reduction goal by 2030, 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 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.

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.



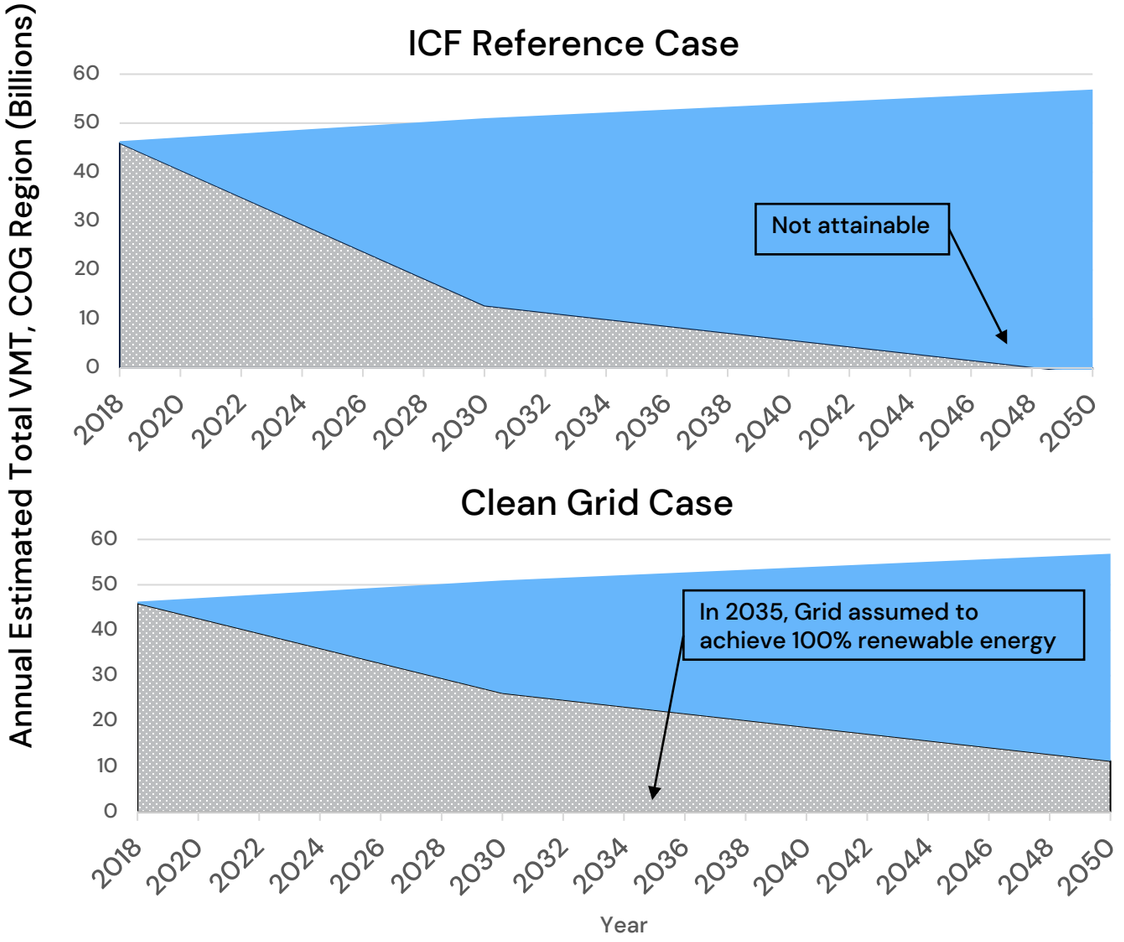


Vehicle Technology Alone

- 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 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

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.

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



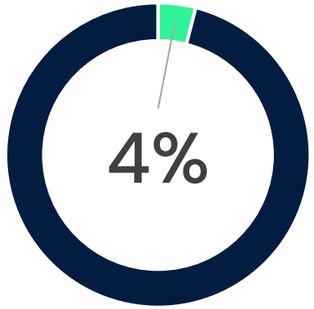
Note: This "top down" analysis used simplified assumptions with proportionate EV adoption across all vehicle classes; more robust analysis using different assumptions about EV adoption by different vehicle classes will be conducted as part of the scenario analysis.

Transportation Systems Management & Operation (TSMO) Strategies Alone

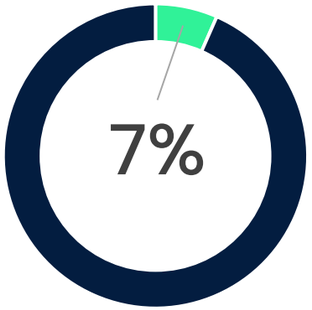
- Studies generally suggest GHG emissions reductions of up to a few percent from TSMO strategies, with smaller percentages observed when looking at the regional scale
- TSMO alone would not be able to achieve fuel economy improvements required to attain the 2030 or 2050 goals

Impacts from selected TSMO strategies

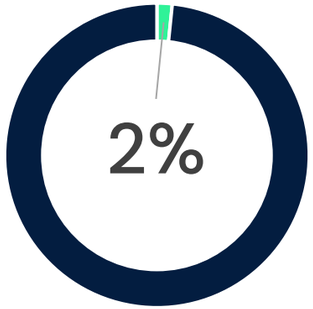
Incident Management Programs (Impacted Roadways Only)[1]



Speed Smoothing (Impacted Vehicles Only)[2]



Multiple Strategies (Regional Scale)[3]

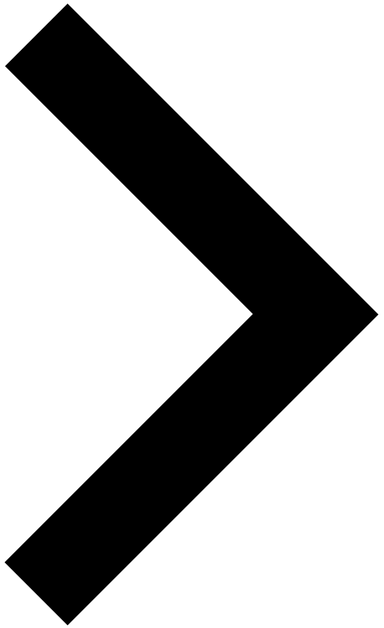


1 Rodier, Caroline, Susan Handy, and Marlon G. Boarnet. "Impacts of Traffic Operations Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions Policy Brief." California Environmental Protection Agency Air Resources Board, September 30, 2014. https://ww2.arb.ca.gov/sites/default/files/2020-06/Impacts_of_Traffic_Operations_Strategies_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf.

2 Liu, Jun, Kara M. Kockelman, and Aqshems Nichols. "Anticipating the Emissions Impacts of Smoother Driving by Connected and Autonomous Vehicles, Using the Moves Model." Washington, D.C., 2018. https://www.ce.utexas.edu/prof/kockelman/public_html/TRB17CAVEmissions.pdf.

3 These multiple strategies include ramp metering, incident management, active signal control, and active transportation demand management including lane control, queue warning, junction control, and traveler information.

Cambridge Systematics, Inc. "Travel and Emissions Impacts of Highway Operations Strategies." Final Report. FHWA Operations. Federal Highway Administration, March 2014.



Scenarios for Analysis

Overview of 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 Operation (TSMO)	TSMO	Transportation System 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 + shared CAV assumptions)

Vehicle Technology and Fuels Improvements

Vehicle Technology and Fuels Improvement Scenarios		
Strategy	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
Medium-and-heavy-duty trucks 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

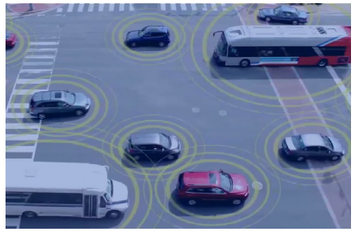
Mode Shift and Travel Behavior Scenarios			
Strategy	MS.1 Scenario	MS.2 Scenario	MS.3 Scenario
Land use changes and bicycle/ pedestrian/ micromobility enhancements	Shifts incremental growth outside of Activity Centers after 2025 to Activity Centers and areas with high-capacity transit stations, and adds 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

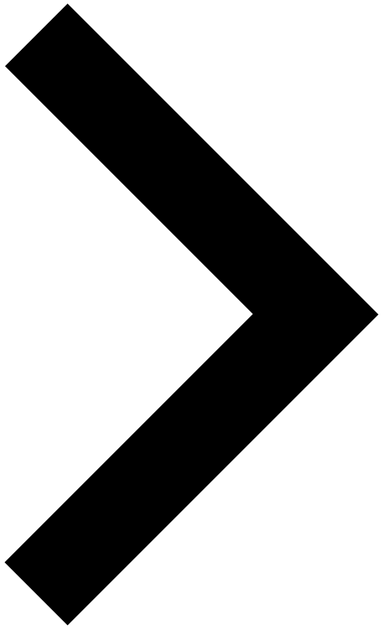
Transportation Systems Management and Operation (TSMO)

Transportation Systems Management and Operations Improvements 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

Combined Scenarios				
	Vehicle Technology and Fuels Improvement Assumptions	Mode Shift and Travel Behavior Assumptions	Transportation Systems Management & Operations Improvements Assumptions	Shared CAV Assumptions
COMBO.1: All Pathways	VT.1	MS.1	TSMO	None
COMBO.2: More Aggressive Technology Emphasis	VT.2	MS.1	TSMO	None
COMBO.3: More Aggressive Mode Shift Emphasis	VT.1	MS.3	TSMO	None
COMBO.4: Most Aggressive Across All Pathways with Shared AV Future	VT.2	MS.3	TSMO	Assumptions about a shared CAV future for 2050 that includes high levels of ridesharing using optimized networks of CAVs (resulting in higher occupancies, reduced VMT, and proliferation of eco-driving benefits)





Electricity Grid Sensitivity Analysis

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

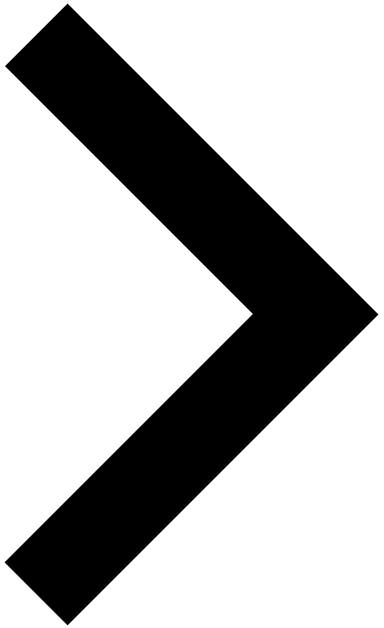
- Based on current on-the books policies in VA, DC, and MD

Modified Reference Case

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

Clean Grid Case

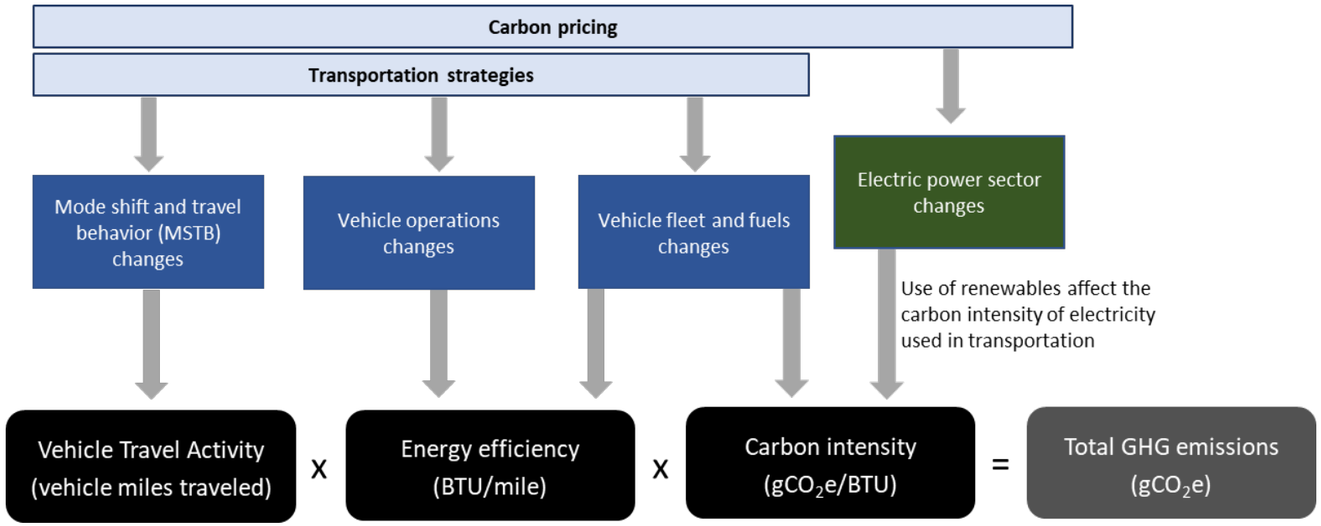
- Most aggressive, assumes 100% clean grid by 2035

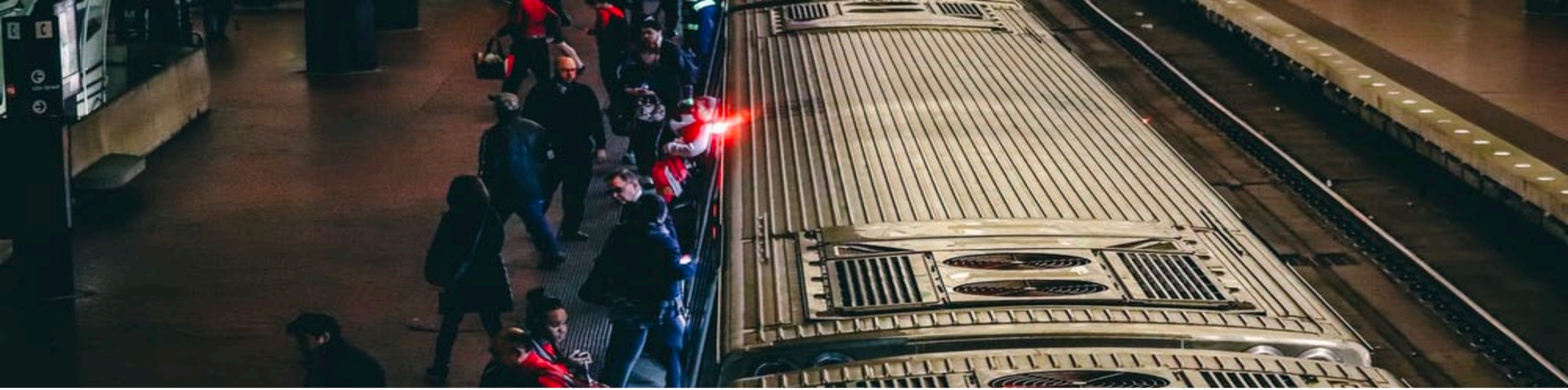


Tools and Models for Analysis

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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