

Appendix B: Strategy Definitions and Assumptions

1.0 Policy Scenario 1 (On-the-Books)

As its name implies, this scenario evaluates the emission reductions from funded projects and programs. This includes projects and programs in the Consolidated Transportation Program (CTP), land development assumptions consistent with local plans and Maryland Department of Planning goals, and GHG reducing projects included in fiscally constrained MPO metropolitan transportation plans.

1.1 2018/2019 MPO Plans and Programs yield lower annual VMT growth (0.6%/year)

Strategy Description: Modeled vehicle miles traveled (VMT) and emissions outcomes from implementation of most recent MPO fiscally constrained long-range transportation plans and cooperative land use forecasts.

Key Assumptions: VMT growth for fiscally constrained plans and programs reflect the most recent available assumptions from MPO long-range plans (consistent with adopted LRTPs and recent amendments) and an updated VMT growth trend from 1990-2017 for counties outside MPO areas (consistent with HPMS data). In the 2018 analysis, the business as usual VMT growth trend (based on 1990-2014) was 1.7% annual and the resulting plans and programs growth rate was 1.4% annual. For this analysis, the business as usual VMT growth trend (based on 1990-2017) is 1.2% annual, and the resulting plans and programs growth rate is 0.6% annual.

1.2 On-Road Technology (Transportation System Management and Operations - CHART and other traffic management technologies)

Strategy Description: Continuation of MDOT SHA's CHART program, Smart Traffic Signals within the Traffic Relief Plan, and ongoing implementation of SHAs TSMO Strategic Plan (2018) and TSMO Master Plan will expand the scope and coverage of advanced traffic management and information systems across Maryland roadways. These technologies help manage incidents and reduce congestion through traffic monitoring, incident management, travel information, communications, and traffic management.

Key Assumptions: MDOT SHAs 2019 Mobility Report documents recent and planned activities to mitigate congestion and improve reliability on Maryland's highway system. This includes TSMO - CHART, signal operations, and smart/adaptive signal systems. Benefits from each of these programs include reduced delay and fuel consumption. Through 2030, these programs are assumed to expand in scope and coverage, consistent with current funding and implementation assumptions, increasing the overall benefit to the system in terms of reduced delay and fuel consumption. In Policy Scenario 1, this translates to increased effectiveness across the CHART coverage area and a 35% expansion of systems on urban arterials and a 15% expansion of systems on rural limited-access facilities.

1.3 Freight and Freight Rail Programs (National Gateway, Howard Street Tunnel, and MTA rail projects)

Strategy Description: Implementation of the CSX National Gateway provides new capacity and eliminates bottlenecks for access to the Port of Baltimore and across MD for rail access westward toward PA and OH

and south toward VA and NC, including rail double-stack service through the expanded Howard Street Tunnel.

Key Assumptions: Opening of the Howard Street Tunnel to doublestack rail service by 2030 will support increased rail throughput to the Port of Baltimore, helping to reduce truck VMT and reduce freight rail congestion. Assumptions for truck VMT reductions and freight rail emissions savings are consistent with assumptions in prior MWCOG analysis of the CSX National Gateway program. To the extent that information is available within the Howard Street Tunnel INFRA Grant application, updated estimates could reflect details within the grant benefit-cost analysis.

1.4 Public Transportation (new capacity, improved operations/frequency, bus rapid transit (BRT))

Strategy Description: This strategy includes projects designed to increase public transit capacity, improve operations and frequency, and new BRT corridors not included in MPO modeling in the plans and programs. This includes North Avenue Rising, MD 355/MD586/US29 BRT in Montgomery County, and MARC reliability/park-and-ride/station improvements.

Key Assumptions: MPO plans account for implementation of the Purple Line, MARC capacity/service improvements, and BaltimoreLink and MTA Commuter Bus service expansions through 2030. This strategy addresses benefits from projects not explicitly modeled in the MPO plans, based on preliminary ridership estimates from planning or alternatives analysis/environmental studies.

1.5 Public Transportation (50% Electric Vehicle (EV) transit bus fleet)

Strategy Description: Applies to replacing MTA and WMATA bus fleets in Maryland (approximately 1,500 buses) to a 50% EV fleet by 2030 (consistent with MDOT's Fleet Innovation Plan).

Key Assumptions: Based on current replacement cycles, MTA could achieve a 50% EV transit bus fleet if all replacement and new vehicles starting in 2025 are EV (assuming appx. 400 buses are replaced over the 5-6 year period, mostly from buses that entered the fleet from 2012 to 2018). This strategy also presumes that WMATA moves toward a 50% EV fleet within Maryland by 2030. For LOTS buses, procurement is expected to generally follow existing MTA direction toward clean diesel, with some limited expansion of electric buses as part of recent and ongoing grant awards.

1.6 Intercity Transportation Initiatives (Amtrak Northeast Corridor, Intercity bus)

Strategy Description: Northeast corridor analysis assumes growth in annual ridership by 2030 for Amtrak consistent with addressing growing demand and benefits created through SOGR investments only through 2030.

Key Assumptions: Annual ridership growth on the AMTRAK Northeast Corridor consistent with high growth 2015 - 2019 will continue through 2030, compared to a lower baseline growth since 2010. Continuing this rate of growth assumes that ongoing planned state of good repair investments and limited capacity expansion enables Amtrak to accommodate growth with new and improved service, and enhanced reliability. Ridership is converted to reduced vehicle miles traveled based on an average Maryland trip length for intercity trips.

1.7 Transportation Demand Management (TDM)

Strategy Description: The following programs are included for consideration towards reduction in VMT: Commuter Connections Transportation Emission Reduction Measures (MWCOG), Guaranteed Ride Home, Employer Outreach, Integrated Rideshare, Commuter Operations and Ridesharing Center, Telework Assistance, Mass Marketing, MTA Transportation Emission Reduction Measures, MTA College Pass, MTA Commuter Choice Maryland Pass, Transit Store in Baltimore.

Key Assumptions: VMT reductions are based on current trends as documented in MDOT's Annual Attainment Report, and results of ongoing and emerging programs within MWCOGs Commuter Connections Program and Commuter Choice Maryland. This analysis assumes implementation of TDM programs consistent with pre COVID-19 conditions related to telework and other TDM incentives.

1.8 Pricing Initiatives (Electronic Tolling)

Strategy Description: Ongoing Conversion to All-Electronic Tolling.

Key Assumptions: Consistent with the 2020-2025 CTP, tolling on MDTA facilities is planned for complete conversion to a cashless system by 2030. This includes programmed investments in video toll collection technologies and implementation of cashless tolling on the Francis Scott Key Bridge (I-695) and Hatem Bridge (US 40) by 2025. MDTA is also implementing an extension of the I-95 Express Lanes to the MD24 interchange, with completion planned before 2030. GHG emissions reduction is associated with a reduction in idling at toll plazas, assumed to average 1 minute per transaction.

1.9 Bicycle and Pedestrian Strategies (Provision of non-motorized infrastructure including sidewalks and bike lanes)

Strategy Description: Assumes VMT reductions due to availability of bicycle facility lane miles and improved bicycle level of comfort consistent with existing and planned infrastructure improvements, repaving, and new facilities highlighted in the 2020 - 2025 CTP and current SHA plans.

Key Assumptions: This strategy assumes that improved directional miles of bicycle facilities and bicycle level of comfort will increase through 2030 consistent with the trend reported in the Annual Attainment Report from 2015 through 2019. This is compared to a do-nothing scenario, resulting in increased bicycle and pedestrian activity and reduced VMT.

1.10 Drayage Truck Replacements

Strategy Description: This strategy estimates the benefit of replacing 600 total dray trucks resulting from MDE, MDOT and Federal grants through 2030, which is based on the current replacement rate.

Key Assumptions: Consistent with current program status and recent EPA grant award, the Port of Baltimore is still on-track to turnover 600 heavy-duty diesel dray trucks by 2030.

1.11 BWI Airport Parking Shuttle Bus Replacements

Strategy Description: This strategy involves replacement of BWI airport parking shuttles - 50 diesel buses with clean diesel buses and CNG buses.

Key Assumptions: Acquisition information based on what is publicly available from MDOT and news sources including the types of vehicles replacing the existing vehicles.

1.12 MDOT Vehicle Fleet (Fleet Innovation Plan)

Strategy Description: Conversion of MDOT fleet (non-revenue vehicles) to EVs (initial focus on MDOT agency passenger vehicle fleet only, heavy duty vehicles included in Policy Scenario 2).

Key Assumptions: Assume 95% EV conversion of 2,114 passenger vehicles by 2030 averaging 12.5k miles per year.

2.0 Policy Scenario 2 (Emerging and Innovative)

This scenario acknowledges that attaining the 2030 goal will require additional investments to expand or accelerate deployment of previously planned strategies, deployment of new best-practice strategies, and capitalizing on the opportunities created by new transportation technologies. All of the strategies in this scenario require additional funding and, in some cases, private sector commitment. The 22 strategies in this scenario (16 emerging and 6 innovative) represent a combination of approaches to reduce GHG emissions with varying levels of confidence and MDOT responsibility.

Emerging Strategies

2.1 TSMO/Integrated Corridor Management (Limited Access System)

Strategy Description: Integrated corridor management, intelligent transportation systems, or advanced traffic management systems for urban restricted access roadways in the state.

Key Assumptions: The most similar program in the 2020-2025 CTP is CHART, which is funded 60% Federal, 40% State. The same share is assumed for this comparable/extended strategy.

2.2 TSMO/Integrated Corridor Management (Arterial System)

Strategy Description: This strategy estimates the benefits of implementing corridor management, intelligent transportation systems, or advanced traffic management systems are in place on all urban arterials.

Key Assumptions: Only urban arterials are being assumed to be covered as part of this strategy through 2030. The most similar program in the 2020-2025 CTP is CHART, which is funded 60% Federal, 40% State. The same share is assumed for this comparable/extended strategy.

2.3 Variable Speeds/Speed Management

Strategy Description: Corridor management (including ramp metering), intelligent transportation systems, or advanced traffic management systems are in place on all urban restricted access facilities and all urban principal and minor arterials. All urban limited access facilities are assumed to be covered.

Key Assumptions: For ramp metering, a two-minute wait time on average was considered during peak hours at ramp entrance. Ramp fraction was estimated at 8% from MOVES defaults. The most similar program in the 2020-2025 CTP is CHART, which is funded 60% Federal, 40% State. The same share is assumed for this comparable/extended strategy.

2.4 Intermodal Freight Centers Access Improvements

Strategy Description: As noted in the Strategic Goods Movement Plan, reliability improvements and congestion mitigation that positively impact supply chain costs associated with driver and truck delay and fuel consumption is a desired outcome. The strategy to achieve this includes SHA and MDTA continuing to advance appropriate measures to reduce or mitigate the effects of congestion on industry supply chains.

Key Assumptions: The strategy has been applied to intermodal sections in Maryland and the mileage is assumed to be similar to the national share of 1.4% (as data on intermodal facilities mileage in MD was not able to be estimated based on available data). Assumed splits according to Freight and Freight Rail programs in PS 1. As noted in the Strategic Goods Movement Plan, reliability improvements and congestion mitigation that positively impact supply chain costs associated with driver and truck delay and fuel consumption is a desired outcome.

2.5 Commercial Vehicle Technologies (Idle Reduction, Low-Carbon Fleet, Dynamic Routing)

Strategy Description: Considers extended idling only and not short term idling (eg. At a delivery/pick-up point. Data requirements for short term idling are more extensive and might not be substantial compared to the extended idling emissions. It is assumed that APUs will be used to power the trucks during the time spent idling.

Key Assumptions: It is assumed that trucks would have spent time idling in absence of new laws/requirements. A high case and a low case for emission reductions is estimated considering all or just 50% of extended idling is handled by Auxillary Power Units (APUs). Negligible costs to the state for enforcement. Truck drivers purchase APUs.

2.6 Regional Clean Fuel Standard

Strategy Description: Consistent with TCI approach assuming a 15% clean fuel standard (applied to fuel consumption from remaining ICE fleet above and beyond RFS). Ultimately this strategy should be deployed as a regional approach for gasoline and diesel fuel.

Key Assumptions: Administration and program management costs to be totally borne by the state.

2.7 Eco-Driving

Strategy Description: Statewide commitment to a marketing and education program and voluntary adoptions by Maryland drivers, including private passenger vehicles and commercial vehicles (light, medium, and heavy-duty trucks).

Key Assumptions: Assumptions based on the extent of government-led programs. Private sector programs not included. For example, fleet operators of trucks, logistical operation enterprises conduct eco-driving for their fleet separately and typically have a higher degree of focus and return on results from the programs. It is assumed that 2% of the statewide population are reached using these general marketing programs. Out of these people, only 50% (1% of total population) have on-board display tools that have on-board display tools that provide feedback from ecodriving. The benefits of eco-driving is two-pronged - one by training and the other due to attention being paid to the on-board display tools. Heavy duty trucks included for this analysis are only assumed to be a part of the general marketing campaign and no specific training provided elsewhere. Modest marketing, education and outreach program costs to be borne by the state.

2.8 Transit capacity/service expansion (fiscally unconstrained, including MTA, WMATA, LOTS, and other intercity providers)

Strategy Description: Potential transit network improvements and expansions noted in BMC and MWCOG long-range plans, in addition to other projects with recent/ongoing planning. This includes the Southern Maryland Rapid Transit Study, Corridor Cities Transitway, additional BRT corridors in Montgomery County, and priority "Early Opportunity" corridors noted in the Central Maryland Regional Transit Plan.

Key Assumptions: The compilation of transit network improvements and expansions in the BMC Maximize2045 plan result in a 0.3% VMT reduction by 2045. This reduction is assumed to be accelerated to 2030, with full implementation of the Mazimize2045 plan (including corridors recommend in the Central Maryland Regional Transit Plan. Other potential transit corridors by 2030 include three additional BRT corridors (MD 650, Randolph Rd., North Bethesda) plus the CCT in Montgomery County and future BRT service in Southern Maryland, consistent with recommendations in the Southern Maryland Rapid Transit Study. The low range assumption assumes that 50% of this system is implemented by 2030, while the high range assumes the entire system is implemented by 2030. Based on transit expansion splits consistent with recent projects and projects in the CTP. This also acknowledges what would be considered a "competitive" funding arrangement for the Federal CIG program (essentially the blanket now for New Starts / Small Starts).

2.9 Expanded Transportation Demand Management (TDM) strategies - Dynamic ridesharing/mobility and non-work demand management

Strategy Description: The TDM programs included in PS1 are broadly expanded consistent with a market-wide implementation of dynamic TDM programs including on-demand ride sharing/shared mobility/microtransit services plus greater market penetration of on-demand deliveries/services through autonomous/drone technologies.

Key Assumptions: There is significant uncertainty in this strategy, given the range of different technologies and services, including many that are led by the private sector. Generally, the assumption is that regular ridesourcing/ridesharing users in Maryland (mobility as a service, micromobility, smart mobility options) range from 10% to 20%, which leads to a reduction in vehicle ownership and overall reduction in travel (ranging from 30% to 60%). These estimates are drawn from academic/industry studies in 2018 and 2019. This includes the potential impact of less non-work trips associated with more at-home deliveries/services. Same as 2018. However, 2018 costs assume that a 100% of the costs are borne by the state, unlike the typical 70%-30% split as assumed in funded PS 1 strategies. The rationale for this is that Federal funds typically

supporting TDM (e.g. CMAQ) are highly competitive and segmented. A broader TDM program will either require new Federal programs or (more likely) a much higher State commitment.

2.10 Expanded bike/pedestrian system development

Strategy Description: Assumes VMT reductions due to availability of bicycle facility lane miles and improved bicycle level of comfort consistent with a 50% increase in existing and planned infrastructure improvements, repaving, and new facilities highlighted in the 2020 - 2025 CTP and current SHA plans.

Key Assumptions: Total improved directional miles would increase from 367 miles in 2019 (per the Attainment Report) to a low range over 1,300 in 2030 (which is a 25% increase over the current growth trend) to a high range over 1,600 in 2030 (which is a 50% increase over the current growth trend). Splits assumed to be similar to the funded bicycle and pedestrian improvements.

2.11 Expanded Telework

Strategy Description: In light of COVID19 the share of people who are teleworking has seen a multi-fold increase compared to the levels a year ago. It has been a near unanimous opinion in the research literature reviewed for this strategy analysis that the increase in telework trends is going to be a long term phenomenon. There are different views about the share of people now teleworking under the COVID19 constraints who will remain to telework long after the impacts of the pandemic.

Key Assumptions: The share of the regular teleworking workforce (>3 days per week) ranges from 32% to 44% in 2030. These shares are applied to 2030 VMT per capita and an assumption that approximately 30% of total VMT per capita is attributed to commuting. Costs of program management assumed—after considering other states and metro area telework programs, a \$10-20 million annual funding was determined to be adequate for a MD-Telework program. If costs to the employers are not assumed, it will lead to underestimation of total costs that are eligible for tax credits, etc. Also, in the case of government employees, the installation and capital costs of equipment, etc., are typically reimbursed.

2.12 MARC Growth and Investment Plan (MGIP) / Cornerstone Plan Completion

Strategy Description: Improvements to MARC service include completion of the fourth track on the Penn Line to facilitate service expansion (which requires new Susquehanna and Bush River crossings and replacement of the B&P Tunnel); reduced peak headways, new midday service, and weekend service on the Camden Line (including expansion to three main tracks between Baltimore and Washington); increased service, longer trains, and expanded parking on the Brunswick Line; and, implementation of VRE-MARC Run-Through Service.

Key Assumptions: Estimated 2030 ridership, consistent with full build-out of the MGIP/Cornerstone Plan, totals over 16 million passengers. Compared to a low and an average annual ridership growth rate through 2030, this could yield a statewide VMT reduction between 107 and 165 million miles in 2030. The VRE-MARC Run-Through Service estimated the potential for over 16,000 trips per day, resulting in a VMT reduction of 30.5 million by 2030. Similar to transit expansion, although typically more access to Federal funds through Federal Railroad Authority funding/grant programs—justifies a higher Federal split.

2.13 Transit-Oriented Development (TOD) Build-Out (20 incentive zones)

Strategy Description: Estimated TOD build-out across 20 locations totals an additional 36,000 households, each with an average VMT reduction of 33% to 56% based on average VMT savings by transit zone density.

Key Assumptions: Based on Center for Neighborhood Technology (CNTs) nationwide 2010 study, average VMT reductions in transit oriented zones compared to traditional urban/suburban development range from 33% to 56%. Using this range, applied to the potential number of new households at buildout, and average VMT per capita, a range of VMT reductions is determined. CTP Special Funding Source. No Federal Aid. 100% State & Local Funding. Assumes additional funding equivalent to what is in the CTP now to be required for 20 zones build out.

2.14 EV Market Share Ramp-up of an additional 255,000 vehicles

Strategy Description: Additional 255,000 EVs by 2030, compared to the TCI projection to reach 790k ZEVs (with Federal action).

Key Assumptions: Same assumptions are applied as in the reference case for the share of BEV vs. PHEVs and proportion of PHEV travel operating as electric. The cost assumption is based on maxing out the current annual EVSE rebates and EV credits under PS 1 and factored for the additional 255,000 EVs.

2.15 Extended CAFE Standards (Model Years 2026-2030)

Strategy Description: Federal fuel economy standards continue to increase from 2026 through 2030.

Key Assumptions: With support of the auto manufacturers and new Administration for the National Program Standards, if the fuel economy standards would continue to increase by five percent per year through 2030, an additional emissions decrease of 0.80 mmt CO₂e would result from the vehicle technology standards.

2.16 50 percent to 75 percent EV Transit Bus Fleet

Strategy Description: Applies to MTA and WMATA bus fleets in Maryland (approximately 1,500 buses).

Key Assumptions: Based on current replacement cycles, MTA could achieve a 50% EV transit bus fleet if all replacement and new vehicles starting in 2025 are EV (assuming appx. 400 buses are replaced over the 5-6 year period, mostly from buses that entered the fleet from 2012 to 2018). To reach a 75% EV fleet, MTA would need to replace an additional 200 buses, which would include new clean diesel buses entering the fleet in 2019-2021 (or would need to change its current replacement cycle and move toward EVs earlier than 2025). Federal/state splits are consistent with current fundign assumption for bus purchases/replacement in the 2020-2025 CTP. However, higher purchase cost of EV transit buses compared to existing clean diesel procurement could ultimately require larger state share.

Innovative Strategies

2.17 Autonomous/Connected Vehicle Technologies

Strategy Description: Core assumptions regarding market penetration of AVs, change in VMT, and fuel savings have been adopted from an ENO study which lays out three scenarios of AV deployment, of which the low-end penetration of 10% by 2030 is considered in this analysis.

Key Assumptions: Emissions associated with VMT increase resulting from mobility benefits (AVs added to the fleet—this increases emissions and thereby a negative impact, estimated at 20 percent increase); fuel savings due to AVs (savings of AVs only, estimated at 13 percent reduction); congestion reduction benefits on freeways and arterials (assumed LOS E to C on restricted access roadways and unrestricted access roadways). These are due to vehicles following automated vehicles, etc. Level of service criteria for restricted and unrestricted roadway types obtained from HCM and emission rates are applied at the different operating speeds (bins) and assigned to VMT by that roadway type (estimated at 15 percent reduction for limited access facilities and 5 percent reduction for arterials). Ranges for high case have been varied to include a higher market penetration (15%) and thereby an increased freeway congestion reduction benefit (20%). Infrastructure costs to the state considered. 100% to be borne by the state.

2.18 Zero-Emission Truck Corridors

Strategy Description: This strategy considers corridors in MD (port connections, etc.) in line with the I-710 Calstart Corridor.

Key Assumptions: More research required to establish potential deployment scenario within Maryland, primarily at the Port of Baltimore. Options include a zero-emissions dray truck program similar to the proposed program in the Los Angeles region, or deployment in specific corridors (eg. where trucks connect into an overhead electric power system. Current approach assumes that from 300 (low) to 700 (high) dray trucks are electrified in Maryland (approx. 20% to 40% of the total dray truck fleet operating at the Port of Baltimore). California examples primarily are currently using VW Mitigation resources to fund truck replacements up to \$200k value. The presumption is that a private share is contributed, but that is unknown. Once VW mitigation trust funding is spent, sources for these programs are uncertain (a fair assumption is a mix of Federal grants, state match or incentives, and private leverage. The cost estimate represents the public share only.

2.19 Freight Villages/Urban Freight Consolidation Centers

Strategy Description: Consolidated freight distribution centers to utilize cleaner last-mile delivery trucks for urban areas (fleet or urban area approach).

Key Assumptions: The benefits are localized to individual intersections/interchanges and ramps, as well as local streets/intermodal connectors providing access to the Port of Baltimore and other intermodal facilities. This is assumed to be implemented on a public-private partnership (PPP) basis. Hence the split was assumed to be 50-50.

2.20 Pay-As-You-Drive (PAYD) Insurance

Strategy Description: PAYD is a usage-based insurance program where charges are based on usage and driver behavior, which is offered by several auto insurance companies in the US. This strategy involves adoption of PAYD insurance, which has been observed in multiple studies to reduce VMT.

Key Assumptions: Range of 10 to 20% of licensed Maryland drivers use a pay-as-you-drive auto insurance premium by 2030. The range of VMT reduction for PAYD insurance is from 8 to 10% based on national research. This reduction is applied to average VMT per capita for the 10 to 20% of Maryland licensed drivers with PAYD insurance premiums. Private insurance providers (administration and marketing) (100%)

2.21 Speed Management on Freeways (increased enforcement)

Strategy Description: Speed Management covering urban and rural restricted access roadways in the state.

Key Assumptions: Assumes coverage of 100% urban restricted access roadways and only 50% of rural restricted access roadways for a high range implementation and 50% urban restricted roadway coverage and 25% rural restricted access coverage for low range implementation. Discounted for peak-period congested travel VMT.

2.22 High-Speed Passenger Rail/SCMAGLEV

Strategy Description: Assumes build-out of the NEC Vision Plan (low range) by 2030 and build-out of NEC Next-Gen Plan (high range) by 2030.

Key Assumptions: Build-out of both of these systems would require a significant influx of Federal and private funding in addition to extensive engineering, environmental, and construction resources to implement. It is highly unlikely given the current Federal funding situation and post-pandemic economic recovery and travel patterns that implementation of such a broad scale expansion of service on the NEC is possible. SCMaglev is assumed to be 100% privately funded. Implementation of the NEC Vision Plan would be primarily Federal, however, there is no funding source existing to support.