



Long Range Transportation Plan Exploratory Scenarios

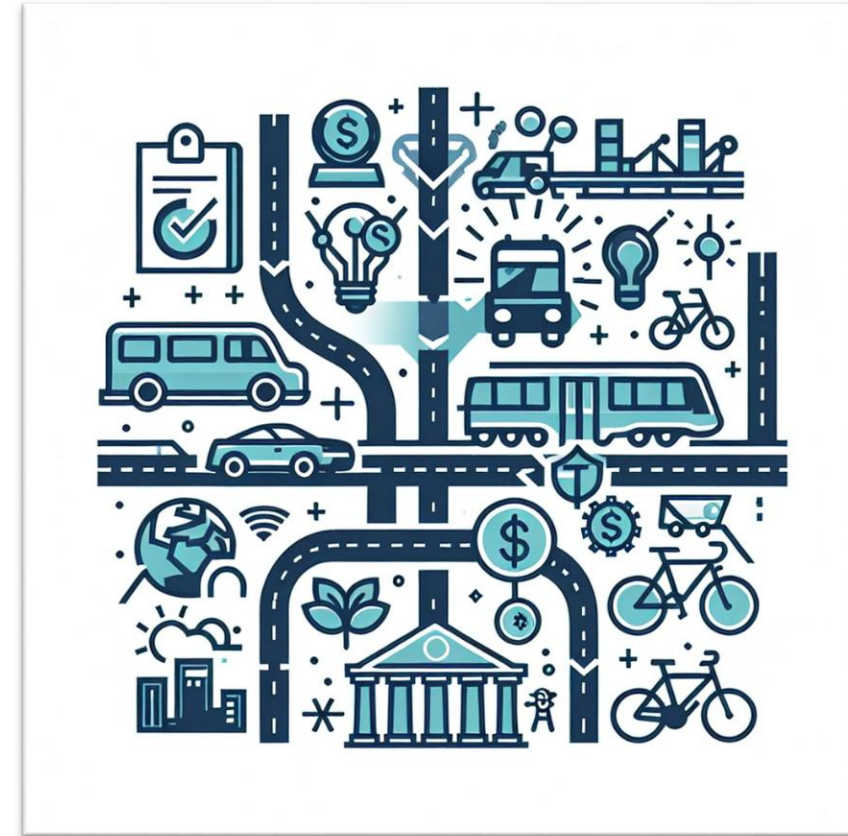
Refined Scenarios Presentation to BRTB Technical Committee

August 5, 2025

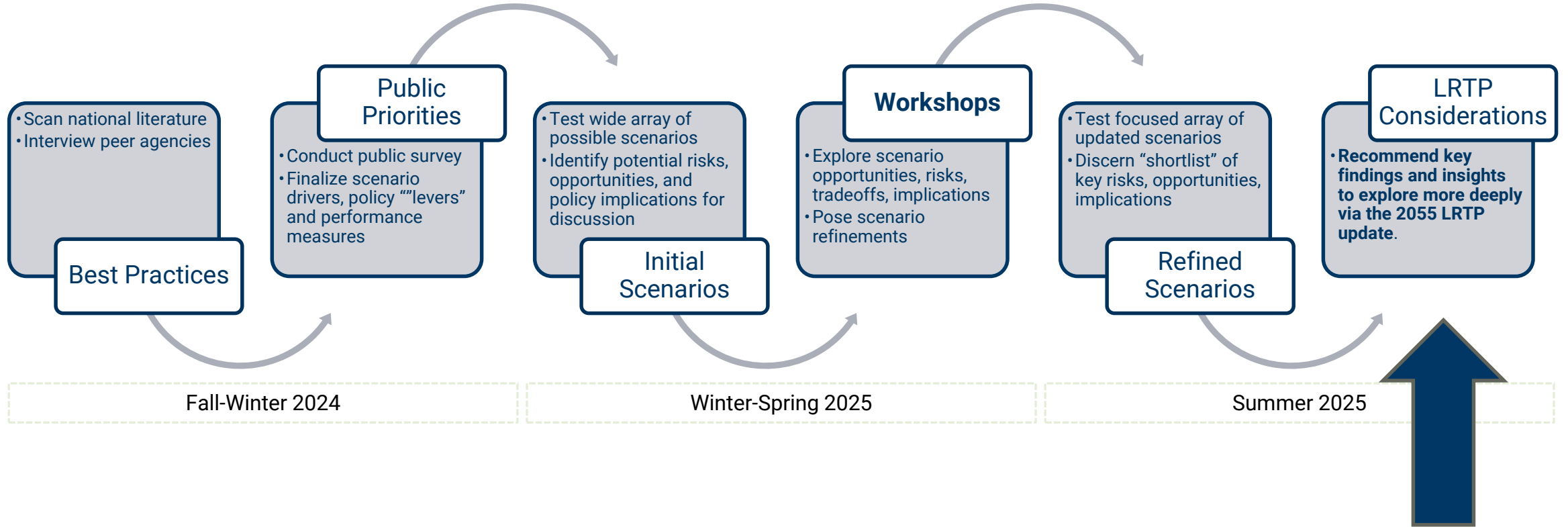


How Can Exploratory Scenario Planning Inform The LRTP?

- **Scenarios explore the effects of alternative policy decisions and external forces such as:**
 - Transportation investment priorities
 - Different amounts and locations of housing and population
 - Fees and other funding mechanisms
 - Economic shifts affecting numbers of jobs and income levels
 - Technology-spurred changes such as EV adoption, autonomous vehicle use, and remote work trends,
 - Changes in environmental conditions such as flooding from sea level rise and severe storms
- **By examining possible alternative futures beyond the current LRTP assumptions, we generate insights to enrich the next LRTP update**



Scenario Development and Evaluation Process



Scenario Model Performance Measures Per LRTP Goals



GOAL

Increase Mobility

Help people and freight to move reliably, efficiently and seamlessly.

Measuring success

- o More Trips by Transit, Biking, and Walking
- o Less Time Stuck in Traffic (Vehicle Delay)
- o Higher Vehicle Travel Efficiency (Travel Time Index [TTI]) on Freeways and Arterials



GOAL

Improve Accessibility

Identify and support multimodal options and systems that are resilient and sustainable and enable all individuals to reach their destinations safely and seamlessly.

Measuring success

- o More Jobs Reachable by Transit, Bike, Or Walk within 20 and 40 minutes



GOAL

Improve System Safety

Reduce the number of crashes, injuries and fatalities experienced by all users of the transportation system toward meeting Zero Deaths Maryland.

Measuring success

- o Fewer Crashes Among Drivers + Passengers
- o Fewer Crashes Among Bicyclists, and Pedestrians



GOAL

Promote Prosperity and Economic Opportunity

Support the vitality of communities and businesses, opportunities for workers and the movement of goods and services within and through the region.

Measuring success

- o Reduced Travel Costs
- o Reduced Travel + Housing Costs



GOAL

Implement Environmentally Responsible Transportation Solutions

Pass on to future generations the healthiest natural and human environment possible.

Measuring success

- o Lower Vehicle Miles Traveled (VMT)
- o Lower Emissions

PRINCIPLE

Fairness

Balance impacts to lower-opportunity areas vs. higher-opportunity areas

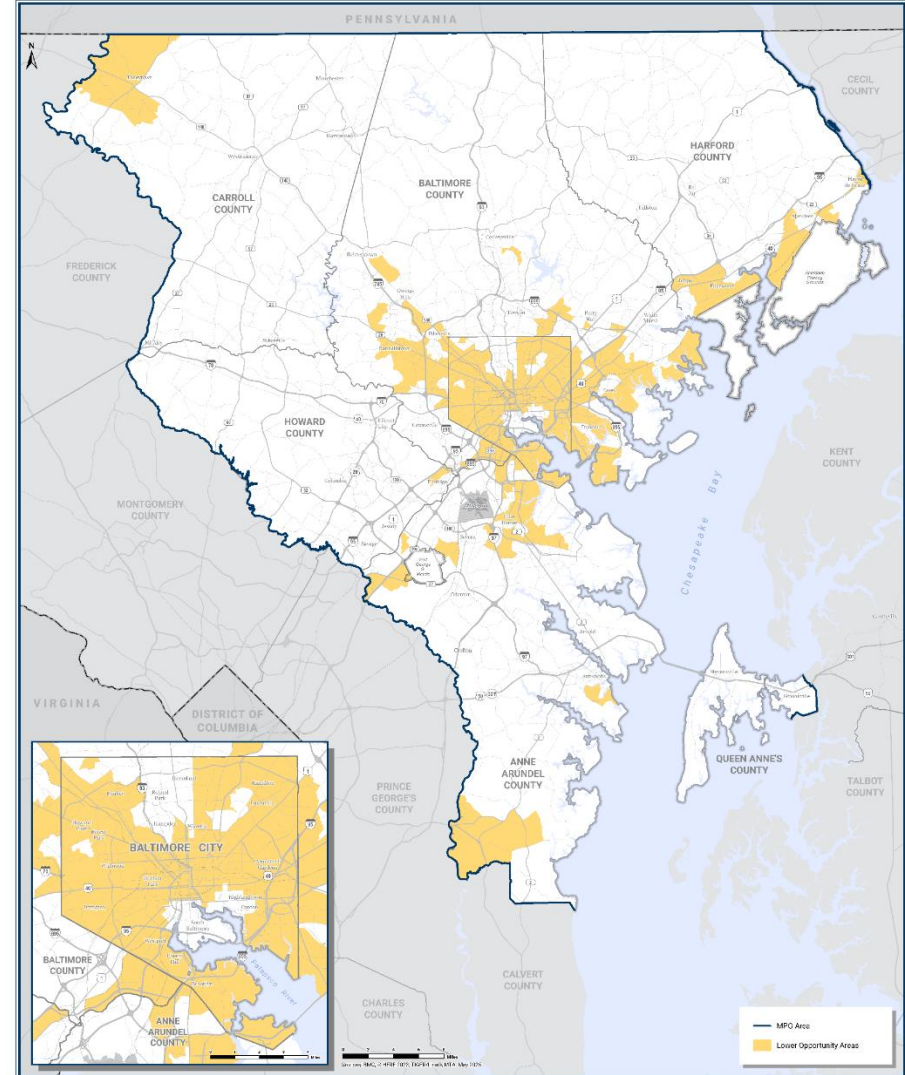
Measuring success

- o For the purpose of the scenario planning exercise, apply this comparison to all results

Lower-Opportunity Areas

- Opportunity Scores from BMC 2025 Regional Fair Housing Plan
- Indicators correlate to average life outcomes by area
 - Educational opportunity (e.g., school performance, share with degrees)
 - Community strength (e.g., vacancy rate, poverty rate, home value)
 - Economic opportunity (e.g., commute time, unemployment rate)
- Lower-opportunity area scores are in the lowest two quintiles of the opportunity indicators
- Scenario impacts on lower-opportunity areas are examined quantitatively and qualitatively

Lower Opportunity Areas



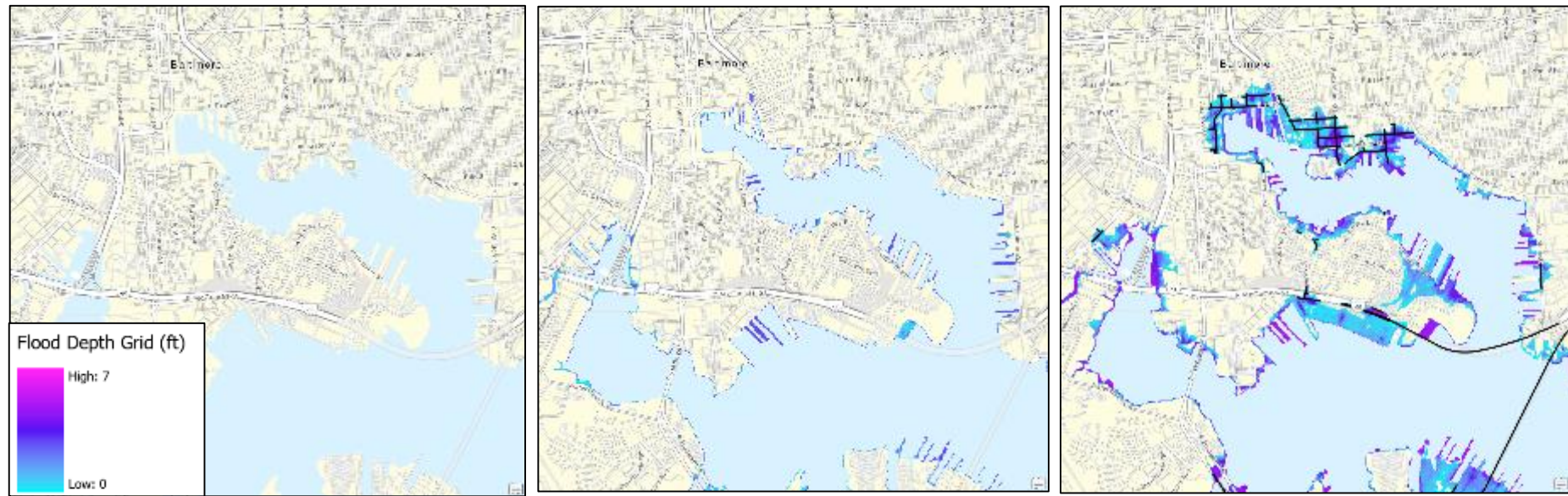
Potential Year 2050 Inundation

Baltimore City Inundation Scenarios

Current Conditions

2050 “New Normal”

2050 Major Storm



- Discern implications on performance outcomes
- Consider policy interventions

Initial Scenarios: Policy Levers and External Forces

Transportation
Investments



Land Use and
Housing



Fees and
Incentives



Economy



Technology

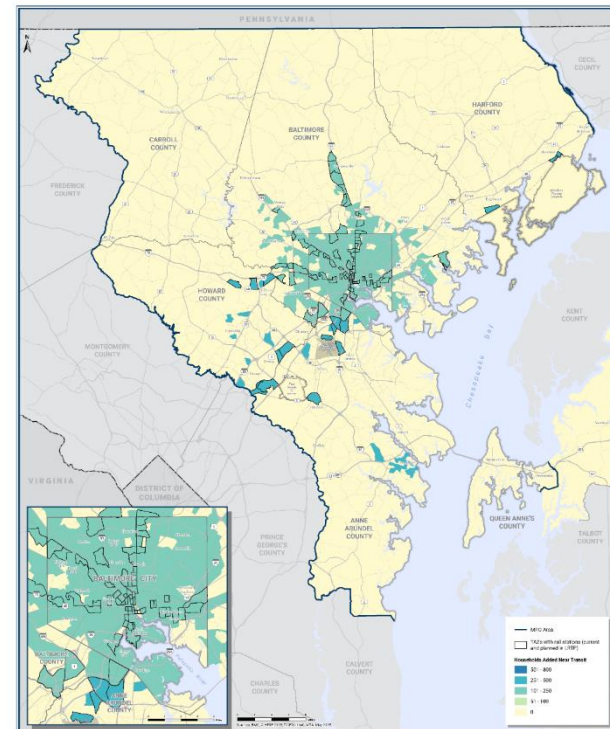


Natural Environment



Land Use Inputs: Distributions of Additional Households

LU Level 1: 90k Households Added Near Transit



Initial Scenario Findings

- Focusing household growth near jobs and / or transit systems influences desired outcomes* enough to be worth further exploration.
- Raising the cost of driving (e.g., gas tax, VMT fee) can significantly boost the effectiveness of transit and land use policies, but increases travel costs for most households
- Increased bicycling and walking activity is a desired outcome, but correlates to higher crash risks.
- Next Steps: Refine scenarios to focus on a few key questions
 - Test new combinations of refined transportation investments and land use policies.
 - Overlay potential impacts of refined fees and incentives
 - Consider policies to deal with tradeoffs such as increased bike/ped crash risks associated with more active transportation trips

* e.g., more active transportation and transit trips, lower VMT and emissions, reduced per capita costs

Refined Scenario Inputs: Four Policy Levers

Transportation Investments (TI)

TI-0: LRTP investments

TI-1: More bike/walk

TI-2: Fewer commute trips (TDM + WFH)

TI-3: More road capacity (TSMO + Lanes)

Transit Investments (TR)

TR-0: LRTP (+15% regionwide vehicle revenue miles (RVRM); +15% frequency (FR) regionwide)

TR-1: +35% RVRM; +35% FR near transit; +25% FR elsewhere

TR-2: +35% RVRM; +35% FR near jobs; +25% FR elsewhere

TR-3: +35% RVRM; + 35% FR near transit + jobs; +25% elsewhere

TR-4: +35% RVRM; +25% FR regionwide

Land Use and Housing (LU)

LU-0: LRTP HH regionwide

LU-1: +90K HH near transit

LU-2: +90K HH near jobs

LU-3: +90K HH near transit & jobs

LU- 4: +90K HH regionwide

Fees and Incentives (Fees)

Fees-0: Current gas tax (53 cents/gal)

Fees-1: Higher gas tax (80 cents/gal)

Fees-2: VMT fee 2.5 cents/mi

Fees-3: Higher VMT fee 5 cents/mi

Fees-4: VMT fee 5 cents; congestion fee 50 cents; +25% parking rate

Refined Analysis

| Step | Activity | Policy Inputs |
|------|---|---------------------|
| 1 | Evaluate impacts of Bike/Walk, TDM, Roadway, and Transit investments independently | TI, TR |
| 2 | Identify high-impact combinations of Bike/Walk, TDM, Roadway, and Transit investments | TI + TR |
| 3 | Identify high-impact land use (growth) policies | LU |
| 4 | Identify high-impact combinations of transportation investments and land use policies | TI + TR + LU |
| 5 | Identify influences of Fees & Incentives on the most impactful transportation + land use combinations | TI + TR + LU + Fees |

Key Outputs

- ✓ Job access by mode
- ✓ Per capita costs
- ✓ Trip-making by mode
- ✓ Crashes by mode
- ✓ Vehicle Miles Traveled (VMT)
- ✓ Emissions
- ✓ Delay

Step 1: Bike/ Walk, TDM, Roadway, and Transit Investments

- Bike/Ped Policies
 - Modest impacts on all outcomes.
- TDM/WFH policies
 - Strongest influence on reducing costs, vehicle crashes, and VMT as well as increasing bike trips.
 - Rivals road capacity improvements at reducing emissions and delay.
 - Stronger influence than bike/ped investments on increasing transit and active transportation trips while generating almost the same low rate of increased bike/ped crashes.
- TSMO/Lanes
 - Rivals TDM/WFH at reducing emissions and delay but increases VMT and crashes for all users.
 - Only policy that reduces transit, bike, and walk trips.
 - Reduces costs by less than any other policy.
- Transit investments in any location
 - Strongest influence on increasing transit and walk trips but also on increased bike/ped crashes.
 - Reduces costs, vehicle crashes, VMT, emissions, and delay.

Next step: Test TDM/WFH policies with/without Transit investments →

Step 2: Transit With Vs. Without TDM/WFH Policies

Similar results for all Transit distribution patterns

- Slightly improves job access by transit
 - + 0.03% with TDM vs +0.01% with transit investments alone
 - Bike/ped access 0% with or without TDM
- **Reduces costs**
 - - 1.1% TDM vs -0.4% transit alone
- **Increases transit and walk trips**
 - Transit + 4.7% TDM vs + 4.3% transit alone
 - Walk + 8.3% TDM vs + 8% transit alone
- Decreases bike trips, increases bike/ped crashes
 - Bike - 0.8% TDM vs -1.2% with transit alone
 - Bike /ped crashes + 5.2% TDM vs + 4.9% with transit alone
- **Decreases VMT**, car crashes, emissions, delay
 - VMT -2.3% TDM vs -0.7% transit alone
 - Car crashes -2.2% TDM vs -0.4% transit alone
 - Emissions -2.2% TDM vs -0.7% transit alone
 - Delay -2.8% TDM vs -0.9% transit alone

Next step: Test land use policies with and without transit investments →

Step 3: Growth With/ Without Additional Transit

- Growth without transit (in any distribution) increases everything, positive and negative
 - Job access and trip-making by all modes
 - Costs and crashes by all modes
 - VMT, emissions and delay.
- **Clustering growth around jobs** or around jobs & transit hubs (with or without increased transit) improves all outcomes
 - Increases job access by biking and walking
 - Increases bike, walk, and transit trips, but also bike/ped crashes
 - Increases VMT, emissions, and delay less than distributing regionwide or solely near transit
- **Adding transit** to any growth distribution improves most outcomes
 - Doesn't impact job access
 - Raises costs but by less than without transit
 - Increases transit and walk trips, slightly reduces bike trips, and increases bike/ped crash rates
 - Reduces vehicle crashes, VMT emissions, and delay

Next step: Add other transportation investments and policies to the mix →

Step 4: Growth+Transit + Bike/Ped, TDM, or TSMO/Lanes

Summary is for all growth+ transit scenarios. Clustering growth+transit near jobs improves positive and lessens negative outcomes

- Bike/Ped policies have modest impacts
 - Job access increases 2-7%, especially bike/ped
 - Costs increase about 0.4%
 - Transit and bike trips increase about 5%-7%.
 - Walk trips increase about 10.5%
 - Bike/ped crashes increase about 8% (lowest of all policies)
 - Vehicle crashes, VMT, emissions, delay increase about 1%
- TDM/ WFH policies contribute most to desired outcomes
 - Job access results are similar to bike/ped
 - Costs drop by about 0.02% - the only policy that doesn't increase costs
 - Transit, bike, and ped trips increase the most, about 7%-11%
 - Bike/ped crashes increase about 8.3%
- Vehicle crashes, VMT, and emissions drop by .03% to .08% - the only policy that reduces VMT & crashes
- Delay increases by 1.9%, more than bike/ped and slightly less than TSMO/lanes
- Increased road capacity mostly yields smaller benefits and more negative outcomes
 - Job access results are similar to bike/ped
 - Costs increase the most, by about 0.5%
 - Transit, bike, and walk trips increase, but about 1% less than other policies
 - Bike/ped crashes increase about 7%, the least of all policies
 - Vehicle crashes, VMT, and delay increase between 1% and 2%, higher than the other policies
 - Emissions drop by about 1%, slightly more than TDM/ WFH policies and 2% more than bike/ped policies.

Step 5: Fees Independent of Any Policies

- Doubling gas tax makes little difference
 - All outcomes change much less than 1%
- 2.5-cent VMT fee has slightly more impact, but not much
 - Job access and trip making don't change
 - Costs increase slightly (+0.2%)
 - Vehicle crashes, VMT decrease slightly (0.2%); emissions increase slightly (0.1%)
 - Delay drops 2.3%
- 5-cent VMT fee has more substantive impacts
 - Slightly higher job access by transit (0.1%)
 - Transit, bike, ped trips increase about 0.6%; bike/ped crashes increase 0.4%
 - **Costs** increase 2%
- Vehicle crashes, VMT, and emissions drop about 3.2%
- **Delay** drops 6.4%
- Multiple-Fee increases some VMT fee impacts
 - Same job access by transit; job access by auto decreases 0.2%
 - Costs increase 3.2%
 - **Transit, bike, and ped trips** increase about 1%; bike/ped crashes increase 0.6%
 - **Vehicle crashes, VMT, and emissions** drop about 4.5%
 - Delay drops same as VMT fee alone (-6.4%)

Finally – Combine VMT & Multiple Fees with highest-impact policies:

TDM/WFH with Growth near Jobs or Jobs+Transit →

Step 5 (cont.): Highest Impact Policy Combinations

TDM/WFH Policies

PLUS *Growth+Transit Near Transit, Jobs, or Both*

PLUS *5-cent VMT or Multiple Fees*

- Job access
 - **Job-focused distribution** increases access to jobs most, about 1.7% by transit and auto; about 7% by bike or walk.
 - Fees didn't change the results.
- Per capita costs
 - Costs went up by about 2% with the VMT fee; 3.2% with **multiple fees**
 - Growth+transit distribution didn't change the results.
- Trip-making and Bike/Ped Crashes
 - Under all distribution and fee scenarios, transit trips increased about 7.6%, bike trips about 6.5%, walk trips about 11.2%. Bike/ped crashes increased about 8.8%, consistent with increased bike/ped trips.
 - **Locating growth near transit + jobs** generated slightly higher trip making and crash rates. **Multiple fees** generated slightly more trips than the VMT fee alone.
- Vehicle Crashes, VMT, Emissions, and Delay
 - VMT, emissions, delay and vehicle crashes decreased by 3.2% to 4% with the **VMT fee** alone, and by 4% to 4.9% with multiple fees.
 - Growth+transit distribution didn't change the results by more than about half a percentage point.

Food For Thought – Transportation Investments

- TDM/ WFH policies to reduce commute trips have a strong impact on desired outcomes.
 - A balance is needed to ensure the highest participation in TDM by people whose jobs require daily commutes and WFH among people whose jobs can be done remotely. What are some strategies to promote WFH for some jobs while advancing non-SOV travel for others?
- Increasing effective roadway capacity by improving TMSO and adding some lanes is effective at reducing delay and emissions, even if VMT increases, as well as improving access to jobs by auto and transit.
 - However, increased capacity does not help much with boosting transit and bike/walk travel.
 - It also introduces the possibility of generating induced automobile traffic, which can lessen the positive effects of better capacity fairly quickly. What would help to avoid induced trips?
- Expanding transit around jobs, or around a mix of jobs and existing transit locations, has a strong impact on many desired outcomes.
 - However, many jobs are clustered in relatively high-income areas that generate high VMT, which may dilute the effectiveness of the higher-proximity transit. Should we make transit more attractive to high-income commuters? And/ or should we pinpoint jobs more likely to be accessed by transit?

Food For Thought – Land Use

- Adding housing increases all types of trips – auto, bike, walk, and transit.
 - Safety countermeasures will be needed to avoid correlated increases in crash rates, especially among bicyclists and pedestrians. **What are effective bike/ ped safety countermeasures?**
- Locating housing near jobs and/ or near both jobs and transit is the most effective way to accommodate growth while minimizing negative impacts such as higher VMT and emissions.
 - As noted under the Transportation topic, many jobs are in areas populated by higher-income residents who aren't as likely to use transit even if it's closer to them. We may need to think more deeply about how to strategically locate housing, transit, and jobs in patterns that are most likely to generate high ridership, reduce automobile dependence, and increase access to opportunity for all residents. **Should we prioritize job growth and affordable housing in transit-accessible locations?**

Food For Thought - Fees

- Fees
 - Introducing a 5-cent VMT fee is powerfully effective at boosting desired outcomes. It's far more effective than doubling the gas tax or introducing a 2.5 cent VMT fee. It's nearly as effective as introducing a suite of fees (5-cent VMT fee plus higher parking rates plus 50-cent congestion fee).
 - Higher costs hit lower-income households harder. Ensuring a meaningful array of transit, bike, walk and other alternatives to driving is an important countermeasure to mitigate the pain of higher driving costs on everyone, and to realize the full benefits of the fee on desired outcomes.
 - What are some policy strategies to lessen the burden of transportation fees on lower-income households?

Other Questions

- **Do the findings seem intuitively right to you?**
 - Any surprises or data we might want to double-check?
- **What would be most helpful to carry forward to the LRTP discussion?**
 - Suggestions for VE and/ or InSITE travel modeling to dig deeper into the findings
 - High-priority policies for consideration by local and regional officials and staff

For More Information

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