

Appendix E.

Additional Supporting Information

This appendix presents additional technical information presented to TATF members or C/CAG staff that informed the recommendations presented in the report. This includes mitigation actions that were considered but rejected for the Program’s toolbox (Section E.1), the relationship between mitigation actions and topics such as highway induced VMT (Section E.2) and density (Section E.3), calculations of the relative cost effectiveness for the various mitigation actions (Section E.4), and the changes in research between CAPCOA’s 2010 and 2021 handbooks used for estimating VMT reductions (Section E.5).

E.1 Mitigation Actions Considered but Rejected

Table E-1 displays mitigation actions that were suggested by TATF members and were not selected for further analysis as a part of the Program. Many of these measures can improve access and opportunity for low income or disadvantaged communities by making it easier for people to travel and live full lives by reducing the cost or time of travel. These actions, which include a variety of improvement types, were not selected for various reasons, such as a lack of available research to quantify VMT/GHG reductions or due to limited effectiveness at reducing VMT/GHG. Therefore, given the essential nexus requirements that there be substantial evidence showing these mitigation actions can reduce VMT/GHG, this Program is not appropriate to fund these measures, and the relevant agencies should seek funding from other sources. Some measures, such as Safe Routes to School infrastructure projects, can be rolled into the local bicycle and pedestrian improvement mitigation actions, as the City of Escondido has done as described in the case study described in **Section 6.2.2.1**. Other GHG reduction measures, such as street trees, either do not provide as effective a mitigation value or do not align with the purpose of the Program to address transportation-related emissions, as documented in **Appendix D**.

Table E-1: Non-Recommended VMT/GHG Mitigation Actions

Proposed Mitigation Action	Action Type	Reason for Removal
Express Bus Service to East Bay	Operational	Removed due to high costs, dispersed market, and the difficulty of scaling operations.
Mobility Wallet	Programmatic	Removed in favor of a subsidized transit pass program, due to limited available research to quantify VMT reductions from subsidizing other mobility services.
Neighborhood Electric Vehicle Share	Operational	Removed due to lack of VMT quantification research. Full sized electric carshare vehicles are included in the mobility hubs mitigation action.
Parking Cash Out and Unbundled Parking	Other	These actions are more suitable as mitigation measures for individual land use projects, rather than a broader mitigation program.
Roadway Pricing	Other	Removed due to lack of clear scope on how roadway pricing system would be structured in San Mateo County
Safe Routes to School	Capital	Pedestrian and bicycle safety infrastructure are included as separate mitigation actions.
Seamless Transit Transfers	Capital/ Operational	Removed due to lack of VMT quantification research
Secure Bicycle/Scooter Parking	Capital	Removed due to lack of VMT quantification research
Street Trees	Capital	Removed due to limited effectiveness when compared to other mitigation actions
Other Community Measures	Capital/ Operational	Funding of local community amenities such as childcare, grocery stores, or health care facilities was not included due to lack of substantial evidence supporting VMT/GHG reductions that could be applied within this program.

E.2 Mitigation Actions and Induced Highway VMT

The California Air Resources Board (CARB) published comment letters addressing the Orange County Interstate 5 express lane capacity improvement project’s Draft Environmental Impact Report (DEIR) on July 18, 2023, and the Yolo 80 Corridor Improvements Project DEIR on January 10, 2024. These letters present CARB’s concerns with the analysis approach used in these DEIRs. The CARB comments that are relevant to this C/CAG study focus on the quantification methods used to assess mitigation measures for highway capacity projects.

First on the Orange County Interstate 5 express lane project, CARB mentions the importance of having a developed scope for proposed mitigation measures, and that there must be sufficient evidence to ensure that the actions are effective. Second, and most importantly, CARB cites research on induced automobile travel demand and how it is affected by improvements to other transportation modes, such as transit service. Typically, the environmental review process analyzes the VMT induced from the new roadway capacity added from these highway lane expansion projects. This induced travel occurs because the time cost of travel has been reduced with the increased highway capacity. This dynamic occurs because drivers

may make new trips that they would have previously avoided, because the time cost of travel has been reduced.

However, CARB, in their letter on the Orange County Interstate 5 express lane project, also highlighted the need to measure and account for the induced automobile travel from the mitigation actions themselves, which is caused by backfilled traffic. In short, some transportation improvements and programs that cause some people to shift from automobiles, such as transit service expansions and fare subsidies, can also induce new private automobile trips from other people who were not previously driving. For example, a transit service expansion could encourage a US 101 driver to use the bus, but the space that is now available on the freeway can motivate another person, who previously was not driving at that time, to take up that newly available roadway space. CARB mentioned the need to account for this induced VMT when analyzing the effects of improvements and programs used to mitigate the VMT from highway expansion projects.

Importantly, CARB also commented that this dynamic does not occur for all potential mitigation actions, and that improvements like affordable housing and roadway pricing do not lead to induced vehicle trips from backfilled roadway space.

The Yolo 80 Corridor Improvements Project DEIR CARB letter raised similar concerns, such as the lack of a lane conversion alternative and questions about the feasibility and costs of the mitigations, and raised additional concerns related to the use of the travel demand model that did not validate within Caltrans' maximum deviation.

E.3 Relationship between Density and VMT Mitigation

The research behind VMT mitigation indicates that many measures often have limited effectiveness at reducing VMT for low density communities. For example, below are the caveats cited in the CARB letter relating to the limitations of transit service at reducing VMT in low density areas that was used in **Figure 5** showing transit-supportive densities.

Increasing frequencies, extending hours of operation, extending existing routes, providing new routes, or providing new express or BRT service are all projects with the goal of providing a reliable transit service that can compete with driving. Combining transit projects with improvements to the active transportation networks or increasing parking costs can further incentivize a mode shift towards transit and away from driving. For these types of transit improvements to be effective at reducing VMT, they need to occur in places where existing roadway congestion is high (i.e., multiple hours of the day), parking is limited and priced, transit travel times are both reliable and competitive with driving, and **population + employment density exceeds about 11,000 per square mile**. Even under these conditions, transit expansion may not produce lower VMT levels because it will result in the same induced travel effects that roadway capacity expansion creates. Basically, people shift from driving to transit thus freeing up

roadway capacity that is quickly consumed by latent demand. This effect has been analyzed and quantified in the same research that was used to support the NCST induced travel calculator.¹¹⁸

E.4 Relative Community Support and Cost Effectiveness Calculations

Table E-2 presents the details used in the relative community support and cost effectiveness calculations presented in **Figure 7**. For community support, the strategies are rated based on the amount of “Most Beneficial” ratings from CBO interviewees. For cost effectiveness, the study team assigned a relative rating on a scale of 1 to 15, with 15 being the most cost-effective strategy and 1 being the least cost-effective strategy to match the community support ratings.

Table E-2: VMT Mitigation Actions Relative Community Support and Cost Effectiveness

Mitigation Action Category	Community Support ¹	Mitigation Action	Cost-per-VMT-Reduced (Lifespan)	Average Cost Effectiveness per Action	Average Cost Effectiveness per Category
Transit Enhancements	11	Rail Service Frequency Expansion	\$0.66	\$0.40	12
		Route ECR Service Frequency Expansion	\$0.48		
		Transit Priority Projects on Major Corridors	\$0.05		
Affordable Housing	15	Affordable Housing	\$0.83	\$0.83	10
Subsidy Programs	9	Transit Pass Incentives	\$35.62	\$19.08	5
		E-Bike Rebate Program	\$2.53		
Community Travel Planning	10	Community-Based Travel Education	\$0.27	\$0.27	13
First/Last Mile Services	11	Mobility Hubs	\$1.25	\$1.39	9
		Micromobility Services	\$2.65		
		Shuttle/Microtransit Services	\$0.26		
Biking/Walking Paths	13	Bicycle Infrastructure	\$42	\$99.37	2
		Pedestrian Infrastructure	\$156.73		
Parking Management	2	Parking Management and Benefit Districts	\$0.003	\$0.003	15

Notes:

1. Community support reflects the strategies that are rated as “Most Beneficial” as presented in **Appendix A**. Most measures are similar in the “Somewhat Beneficial” category and only Parking Management was rated with more than 1 “Not at all beneficial” rating.

Source: Fehr & Peers, 2024.

¹¹⁸ Duranton, G., & M. A. Turner (2011). The Fundamental Law of Road Congestion: Evidence from US Cities. *American Economic Review*, 101(6), 2616-2652.

E.5 Measures included in the 2010 and 2021 CAPCOA handbooks

Table E-3 presents the VMT mitigation strategies included in the 2010 and 2021 CAPCOA guide. There were several changes between these two editions, which are used by lead agencies throughout California when developing VMT mitigation and TDM measures.

Table E-3: CAPCOA VMT Mitigation Actions and Changes

Mitigation Strategy	CAPCOA 2010 Measure(s)	CAPCOA 2021 Measure(s)	Notes
Land Use			
Increase land use density	LUT-1: Increase Density	T-1: Increase Residential Density T-2: Increase Job Density	The 2021 edition of the CAPCOA handbook provides different quantification methods for residential and employment land uses
Increase land use diversity	LUT-3: Increase Diversity of Urban and Suburban Developments (Mixed Use)	Not included	This measure is not directly included in the 2021 handbook, but it is indirectly included as Measure T-3 Provide Transit-Oriented Development
Locate project in high accessibility area	LUT-4: Increase Destination Accessibility	Not included	This measure is not directly included in the 2021 handbook, but it is indirectly included as Measure T-3 Provide Transit-Oriented Development
Transit oriented development	LUT-5: Increase Transit Accessibility	T-3: Provide Transit-Oriented Development	
Affordable Housing	LUT-6: Integrate Affordable and Below Market Rate Housing	T-4: Integrate Affordable and Below Market Housing	
Improve street connectivity	Not included	T-17: Improve Street Connectivity	This measure increases the density of intersections in a roadway network, removing cul-de-sacs and dead-end streets, making an area easier to navigate for pedestrians
Trip Reduction Programs			
Employer Trip Reduction Programs	TRT-1: Implement Commute Trip Reduction Program – Voluntary	T-5: Implement Commute Trip Reduction Program (Voluntary)	
	TRT-2: Implement Commute Trip Reduction Program – Required Implementation/ Monitoring	T-6: Implement Commute Trip Reduction Program (Mandatory Implementation and Monitoring)	

Mitigation Strategy	CAPCOA 2010 Measure(s)	CAPCOA 2021 Measure(s)	Notes
Trip Reduction Marketing	TRT-7: Implement Commute Trip Reduction Marketing	T-7: Implement Commute Trip Reduction Marketing	
Provide Ridesharing Program	TRT-3: Provide Ride-Sharing Programs	T-8: Provide Ridesharing Program	
Implement Subsidized or Discounted Transit Program	TRT-4: Implement Subsidized or Discounted Transit Program	T-9: Implement Subsidized or Discounted Transit Program	
Provide end-of-trip bicycle facilities	TRT-5: Provide End of Trip Facilities	T-10: Provide End-of-Trip Bicycle Facilities	
Provide employer-sponsored vanpool	TRT-11: Provide Employer-Sponsored Vanpool/Shuttle	T-11: Provide Employer-Sponsored Vanpool	
Price Workplace Parking	TRT-14: Price Workplace Parking	T-12: Price Workplace Parking	
Implement employee cash-out	TRT-15: Implement Employee Parking "Cash-Out"	T-13: Implement Employee Parking Cash-Out	
Community-based travel planning	Not included	T-23: Provide Community-Based Travel Planning	
Pricing and Parking Management			
Provide electric vehicle chargers	Not included	T-14: Provide Electric Vehicle Charging Infrastructure	This measure can only be used as a GHG mitigation strategy, as it does not reduce VMT.
Limit parking supply	PDT-1: Limit Parking Supply	T-15: Limit Residential Parking Supply	This strategy was limited to residential developments in the 2021 edition, as evidence shows it has the strongest VMT reduction effects.
Unbundle parking costs	PDT-2: Unbundle Parking Costs from Property Costs	T-16: Unbundle Residential Parking Costs from Property Cost	This strategy was limited to residential is in the 2021 edition.
Price on-street parking	PDT-3: Implement Market Price Public Parking (On-Street)	T-24: Implement Market Price Public Parking	

Mitigation Strategy	CAPCOA 2010 Measure(s)	CAPCOA 2021 Measure(s)	Notes
Neighborhood Design			
Pedestrian Improvements	SDT-1: Provide Pedestrian Network Improvements	T-18: Provide Pedestrian Network Improvement	
Project Site Bicycle Facilities	SDT-5: Incorporate Bike Lane Street Design (on-site) SDT-6: Provide Bike Parking in Non-Residential Projects SDT-7: Provide Bike Parking in Multi-Unit Residential Projects	Not included	The bicycle facility measures in the 2021 edition focus on community scale improvements, like adding bicycle lanes to public streets.
Community Bicycle Infrastructure	Not included	T-19-A: Construct or Improve Bike Facility T-19-B: Construct or Improve Bike Boulevard T-20: Expand Bikeway Network	The bicycle measures in the 2010 edition only focus on adding facilities at individual project sites, such as adding bicycle parking to apartment buildings.
Carshare Programs	Not included	T-21-A: Implement Conventional Carshare Program T-21-B: Implement Electric Carshare Program	
Bikeshare and Scootershare Programs	Not included	T-22-A: Implement Pedal (Non-Electric) Bikeshare Program T-22-B: Implement Electric Bikeshare Program T-22-C: Implement Scootershare Program	

Mitigation Strategy	CAPCOA 2010 Measure(s)	CAPCOA 2021 Measure(s)	Notes
Transit			
Transit service Enhancements	TST-3: Expand Transit Network	T-25: Extend Transit Network Coverage or Hours	
	TST-4: Increase Transit Service Frequency/Speed	T-26: Increase Transit Service Frequency	
Transit supportive roadway improvements	Not included	T-27: Implement Transit-Supportive Roadway Treatments	
Bus rapid transit (BRT)	TST-1: Provide a Bus Rapid Transit System	T-28: Provide Bus Rapid Transit	
Reduce transit fares	Not included	T-29: Reduce Transit Fares	

Source: Fehr & Peers, 2024.