Appendix F1—Menu of Travel Demand Management Measures, Alameda County TDM Program: City and Public Agency Measures

TDM Program	Description	Primary Agency Responsible	City Implementation Mechanism	Recommended Application/ Context	% Trip Reduction	Factors	Source
Trip Reduction Requirements							
Set trip reduction requirements for multifamily residential or commercial development	Require as a condition of approval for developments (either commercial, multifamily residential, or both) that certain TDM measures are implemented on an ongoing basis, or that specified vehicle trip reduction requirements are met.	Cities	Planning code or other municipal ordinance	Any urban area with good transit service; suburban downtowns, commercial and mixed use areas; transit stations. (particularly in high-growth areas)	5%-15%; Enables other strategies	Effects of this strategy depend on the location/accessibility of the development site(s), demographics of the project's residential/commercial occupants/ tenants and the type of measures required. The US EPA notes that "reasonable initial targets for the programs established under a trip reduction ordinance (TRO), might be a 5-10 percent reduction in single occupant vehicle (SOV) trips, with somewhat larger reductions (perhaps 15 percent) if substantial fees for parking are imposed."	https://www.epa.gov/state-and-local-transportation
Establish a Transportation Management Association	Establish an organization to assist businesses in reducing vehicle trips, either by administering programs, providing services (such as shuttle service), or providing technical assistance to businesses. Often implemented together with a trip reduction requirement.	Cities or business associations	Planning code or other municipal ordinance; or voluntary action by business association	Commercial area or other major business or employment districts	6%-7%	The TDM Resource Center (1997) estimated that just by improving coordination, and providing information on travel alternatives, establishment of a TMA can reduce commute-related vehicle trips by 6%-7%, with greater impact when implemented in concert with other trip reduction, TDM and parking management programs and services.	TDM Resource Center (1997), Transportation Demand Management; A Guide to Including TDM Strategies in Major Investment Studies and in Planning for Other Transportation Projects, Office of Urban Mobility, WSDOT (www.wsdot.wa.gov), as cited in the Victoria Transportation Policy Institute's TDM Encyclopedia (http://www.vtpi.org/tdm/tdm44.htm), last updated in 2017.
Implement an employee-trip reduction program for municipal employees	Appoint an employee commute coordinator, and implement incentive programs to reduce single-occupant vehicle commuting among municipal employees. Elements may include: subsidized transit passes; employee parking and/ or parking cash-out programs; commuter checks; direct financial incentives to bike, walk, carpool or take transit; ride sharing; shuttles; vanpools	Cities	Modify agency procedures	Any	4-20%	Management support and the presence of an onsite employee transportation coordinator are important factors in the success of a program. Mandatory employee/commute trip reduction (CTR) ordinances often require employers with more than 50 or 100 employees at a given employment site to implement a CTR program. This reduces the costs of administering TDM programs and compliance with survey and reporting requirements, but prevents such programs from reaching the majority of employees in a given city/region who work for small to mid-sized firms and organizations with less than 50 employees.	Marlon G. Boarnet, Hsin-Ping Hsu and Susan Handy (2010), Draft Policy Brief on the Impacts of Employer-Based Trip Reduction Based on a Review of the Empirical Literature, for Research on Impacts of Transportation and Land Use-Related Policies, California Air Resources Board http://arb.ca.gov/cc/sb375/policies/policies.htm); Philip Winters and Daniel Rudge (1995), Commute Alternatives Educational Outreach, National Urban Transit Institute, Center for Urban Transportation Research, University of South Florida; Tom Rye (2002), "Travel Plans: Do They Work?," Transport Policy, Vol. 9, No. 4 (www.elsevier.com/locate/tranpol), Oct. 2002, pp. 287-298.
Safety Net							
Guaranteed/ Emergency Ride Home program	Provide a guaranteed ride home for people who do not drive to work alone to ensure they are not stranded if they need to go home in the middle of the day due to an emergency, or stay late for work unexpectedly.	GRH in Alameda County is provided by Alameda CTC		Any	9%-38%	Coupled with active program marketing by employers, including marketing of other TDM programs and financial incentives, such as parking pricing, the Alameda County Guaranteed Ride Home program has been shown to reduce drive alone vehicle trips to participating employment sites by as much as 38% (Alameda County Guaranteed Ride Home Program Evaluation, Nelson\Nygaard 2015 annual evaluation).	Alameda County Guaranteed Ride Home Program Evaluation (Nelson\Nygaard 2015, http://grh.alamedactc.org/wp-content/uploads/2016/06/ALAMEDA-CTC-GRH-Evaluation-2015-FINAL.pdf).

Appendix F1—Menu of Travel Demand Management Measures, Alameda County TDM Program: City and Public Agency Measures, Continued

TDM Program	Description	Primary Agency Responsible	City Implementation Mechanism	Recommended Application/ Context	% Trip Reduction	Factors	Source
Parking Management							
Demand-responsive pricing of on-street spaces	Set on-street parking prices based on parking demand in area to achieve parking availability targets.	Cities	Municipal code; capital project	Urban or suburban downtowns, commercial and mixed use areas; transit stations	4%-18%	One of the most significant factors affecting motorists' choice of whether to drive or travel by another mode is the price of parking at the destination. Moreover, up to 28% of traffic in mixed-use districts is attributable to cruising for parking. By encouraging use of alternative modes and reducing parking search related delays for transit, demand responsive pricing can significantly reduce vehicle trips to major destinations/districts. The impact of parking pricing depends on the overall supply and availability of both on-street and off-street parking and the extent to which employers subsidize such parking.	Low-end estimate per Harvey and Deakin (1997), who estimated that parking pricing for work and non-work trips would reduce regional vehicle trips by 2.8% (Greig Harvey and Elizabeth Deakin (1997), "The STEP Analysis Package: Description and Application Examples," Appendix B, in Apogee Research, Guidance on the Use of Market Mechanisms to Reduce Transportation Emissions, US EPA (Washington DC; www.epa.gov/omswww/market.htm)). High end estimated based on the Victoria Transportation Policy Institute (2016), Trip Reduction Tables (http://www.vtpi.org/tdm/tdm41.htm). Additional resource: http://www.spur.org/publications/spur-report/2009-05-01/critical-cooling.
Use of new meter technologies to allow multiple forms of payment and dynamic pricing	Install parking meters that allow payment by credit card or phone, and that connect to a central system in real-time, allowing for remote programming and management of parking prices.	Cities	Capital project	Urban or suburban downtowns, commercial and mixed use areas; transit stations	Enables demand responsive parking pricing	Installation of new parking management technologies, including new meters and infrastructure to support payment by cell phone and real-time monitoring of parking space utilization and turnover enable implementation of demand responsive parking pricing, which in turn reduces vehicle travel (see Demand Responsive Parking Pricing).	San Francisco Planning and Urban Research (2009). "Critical Cooling," The Urbanist, Issue 482, May, 2009 (http://www.spur.org/publications/spur-report/2009-05-01/critical-cooling).
Use of parking revenue to support other mobility/ neighborhood programs	Dedicate meter revenue from designated area to uses such as mobility improvements, neighborhood or business improvement programs, potentially through the creation of a parking benefit district.	Cities	Form dedicated Transportation Management District to receive funds	Any area with paid parking	Enables investment in Multimodal Infrastructure and TDM Programs	Creation of parking benefit district can directly support vehicle trip reduction by providing funding for investments in other multimodal access programs and services that increase opportunities for access by non-auto modes. The establishment of such districts and provisions requiring meter and permit revenues to be spent within the district can also indirectly support vehicle trip reduction by increasing local political support for demand responsive, market-based pricing of on-street and off-street parking.	
Require "Unbundling" of parking costs from rents and leases	Separate the charge for leasing or buying a unit or square footage in multifamily residential or commercial buildings from charges for parking spaces.	Cities	Modify planning code	Any	6%-16%	"Charging separately for parking is among the most effective strategies to encourage households to own fewer cars, and subsequently reduce vehicle trips. Parking costs are generally subsumed into the sale or rental price of housing and commercial real estate. For residential development, unbundled parking may prompt some residents to dispense with one of their cars and to make more of their trips by other modes. The elasticity of vehicle ownership with respect to price is typically -0.4 to -1.0. Assuming total annual vehicle spending of $7,788 (BLS Consumer Expenditure Survey, 2011), unbundling of an average of $100/month in parking costs would increase perceived transportation costs/vehicle by 15%/year for the typical hh, which in turn is expected to result in a decline in vehicle ownership of 6% (at a price elasticity of -0.4) to 16% (at -0.10), with corresponding declines in vehicle trips."	Victoria Transport Policy Institute (2017), Transportation Elasticities, http://www.vtpi.org/tdm/tdm11.htm; Bureau of Labor Statistics (2012), Consumer Expenditure Survey, 2011, www.bls.gov.

Appendix F1—Menu of Travel Demand Management Measures, Alameda County TDM Program: City and Public Agency Measures, Continued

TDM Program	Description	Primary Agency Responsible	City Implementation Mechanism	Recommended Application/ Context	% Trip Reduction	Factors	Source
Parking Management, Continued							
Reduced or eliminated minimum parking requirements	In areas that are well-served by transit and other alternatives to driving, allow developers to build residential and commercial buildings with fewer parking spaces or no parking.	Cities	Modify planning code	Any area with quality transit service	9%-16%	Eliminating or reducing off-street parking requirements allows a market based supply of parking, and eliminates the sometimes required over-supply of parking, which encourages property owners/managers to bundle parking in lease/sale agreements and provides an effective subsidy for vehicle travel. This policy reform does not directly influence vehicle travel demand associated with existing development, although elimination of minimum off-street parking requirements does remove a barrier to changes of use, and/or the lease or sale of underutilized private off-street parking constructed in accordance with previous requirements, supporting the development of market-based parking pricing that in turn reduces vehicle travel.	Range of vehicle trip reduction impact of eliminating minium parking requirements on Los Angeles' Westside, as incorporated in the vehicle trip reduction impact analysis conducted for the Los Angeles Westside Mobility Plan (http://www.westsidemobilityplan.com/transportation-demand-model/)
District-based parking management	Manage parking supply in a defined area as a unified whole in order to better manage parking demand between different facilities to eliminate cruising for parking and improve the customer experience.	Cities	Modify city agency procedures;	Urban or suburban downtowns, commercial and mixed use areas; transit stations	Enables compact development	District-based parking management offers the same benefit as shared parking facilities at a wider scale. As with shared parking facilities, the coordinated provision and management of a shared, publicly accessible supply of on-street and off-street parking at a district-scale can reduce vehicle trips by facilitating dense/compact, clustered, and mixed-use development and by reducing expenditure of land and financial resources on off-street parking, thereby reducing an effective subsidy for auto access and mobility.	
Incentivize shared parking	Facilitate the sharing of parking among multiple land uses that have complementary schedules (e.g., an office with greater demand during the day and restaurant with greater demand at night).	Enabled by cities, brokered by private businesses or developments	Modify planning code	Urban or suburban downtowns, commercial and mixed use areas	Enables compact development	Shared parking facilities can reduce vehicle trips by reducing the need for construction of dedicated off-street parking facilities for each land use/activity commensurate with the peak parking demand for that use. By so doing, shared parking facilities can enable dense, clustered development that facilitates a greater share of trips by walking, cycling and public transit. Shared parking can also reduce the total amount of land and financial resources dedicated to parking facilities, in turn reducing the effective subsidy for access by automobile that such expenditures represent. However, if shared parking increases available parking supply and thereby reduces parking prices it may in some cases increase vehicle trips and vehicle miles traveled (VMT).	Shared parking does not directly reduce vehicle travel if it substitutes for increased parking supply. To the degree that it increases the available supply of parking and reduces parking prices it can encourage automobile travel. To the degree that shared parking allows more clustered development can encourage use of alternative modes.
Improved parking wayfinding signage	Install wayfinding signage to make parking easier to find. This can help to shift parking demand away from overfull spaces to underutilized areas and can help reduce local traffic impacts caused by searching for parking.	Cities	Capital project	Urban or suburban downtowns, commercial and mixed use areas; transit stations	Not available	Enhanced wayfinding, signage, and provision of real-time information about parking supply and availability can reduce VMT and traffic congestion by reducing parking search time, but impacts on total vehicle trips are unclear.	
Urban Form and Land Use							
Compact, mixed use development and "park once" districts	Encourage development of districts that allow people to park just once if they drive to reach the district, and walk to destinations within the area once they are there.	Cities are responsible for zoning, land use planning, and development permissions	Amending general plans and zoning codes to plan for and facilitate compact, mixed-use development in appropriate areas. Support implementation of compact, mixed-use development by establishment of public development commissions and other mechanisms to support public investment.	Urban; suburban downtown; transit station	20%-40%	Recent literature indicates that compact development can reduce VMT per capita by 20%-40% compared to conventional "sprawl type" development characterized by low density and segregation of land uses and activities (vehicle trips are assumed to be reduced by a corresponding 20%-40%). Cumulative effects depend on the pace of new development in the County relative to the base of existing development (at a more rapid pace and extensive geographic scale, compact/mixed-use development/redevelopment can lead to greater reduction in vehicle trips.	Ewing, R. K. Bartholomew, S. Winkelman, J. Walters, and D. Chen (2008). Growing Cooler: The Evidence on Urban Development and Climate Change. Washington, DC: Urban Land Institute (ULI), p. 33.

Appendix F2—Menu of Travel Demand Management Measures, Alameda County TDM Program: Public or Private Organization Measures

TDM Program	Description	Primary Agency Responsible	City Implementation Mechanism	Recommended Application/ Context	% Trip Reduction	Factors	Source
Trip Reduction							
Establish a Transportation Management Association	Establish an organization to assist businesses in reducing vehicle trips, either by administering programs, providing services (such as shuttle service), or providing technical assistance to businesses. Often implemented together with a trip reduction requirement.	Businesses	Voluntary action by business association	Commercial area or other major business or employment districts	6%-7%	The TDM Resource Center (1997) estimated that just by improving coordination, and providing information on travel alternatives, establishment of a TMA can reduce commute-related vehicle trips by 6%-7%, with greater impact when implemented in concert with other trip reduction, TDM and parking management programs and services.	TDM Resource Center (1997), Transportation Demand Management; A Guide to Including TDM Strategies in Major Investment Studies and in Planning for Other Transportation Projects, Office of Urban Mobility, WSDOT (www.wsdot.wa.gov), as cited in the Victoria Transportation Policy Institute's TDM Encyclopedia (http://www.vtpi.org/tdm/tdm44.htm), last updated in 2017.
Implement an employee-trip reduction program	Appoint an employee commute coordinator, and implement incentive programs to reduce single-occupant vehicle commuting among municipal employees. Elements may include: subsidized transit passes; employee parking and/or parking cash-out programs; commuter checks; direct financial incentives to bike, walk, carpool or take transit; ride sharing; shuttles; vanpools.	Businesses		Any	4-20%	Management support and the presence of an onsite employee transportation coordinator are important factors in the success of a program. Mandatory employee/commute trip reduction (CTR) ordinances often require employers with more than 50 or 100 employees at a given employment site to implement a CTR program. This reduces the costs of administering TDM programs and compliance with survey and reporting requirements, but prevents such programs from reaching the majority of employees in a given city/region who work for small to mid-sized firms and organizations with less than 50 employees.	Marlon G. Boarnet, Hsin-Ping Hsu and Susan Handy (2010), Draft Policy Brief on the Impacts of Employer-Based Trip Reduction Based on a Review of the Empirical Literature, for Research on Impacts of Transportation and Land Use-Related Policies, California Air Resources Board http://arb.ca.gov/cc/sb375/policies/policies.htm); Philip Winters and Daniel Rudge (1995), Commute Alternatives Educational Outreach, National Urban Transit Institute, Center for Urban Transportation Research, University of South Florida; Tom Rye (2002), "Travel Plans: Do They Work?," Transport Policy, Vol. 9, No. 4 (www.elsevier.com/locate/tranpol), Oct. 2002, pp. 287-298.
Safety Net							
Guaranteed/ Emergency Ride Home program	Provide a guaranteed ride home for people who do not drive to work alone to ensure they are not stranded if they need to go home in the middle of the day due to an emergency, or stay late for work unexpectedly.	GRH in Alameda County is provided by Alameda CTC		Any	9%-38%	Coupled with active program marketing by employers, including marketing of other TDM programs and financial incentives, such as parking pricing, the Alameda County Guaranteed Ride Home program has been shown to reduce drive alone vehicle trips to participating employment sites by as much as 38% (Alameda County Guaranteed Ride Home Program Evaluation, Nelson\Nygaard 2015).	Alameda County Guaranteed Ride Home Program Evaluation (Nelson\Nygaard 2015, http://grh.alamedactc.org/wp-content/uploads/2016/06/ALAMEDA-CTC-GRH-Evaluation-2015-FINAL.pdf).
Parking Management							
Incentivize shared parking	Facilitate the sharing of parking among multiple land uses that have complementary schedules (e.g., an office with greater demand during the day and restaurant with greater demand at night).	Enabled by cities, brokered by private businesses or developments	Modify planning code	Urban or suburban downtowns, commercial and mixed use areas	Enables compact development	Shared parking facilities can reduce vehicle trips by reducing the need for construction of dedicated off-street parking facilities for each land use/activity commensurate with the peak parking demand for that use. By so doing, shared parking facilities can enable dense, clustered development that facilitates a greater share of trips by walking, cycling and public transit. Shared parking can also reduce the total amount of land and financial resources dedicated to parking facilities, in turn reducing the effective subsidy for access by automobile that such expenditures represent. However, if shared parking increases available parking supply and thereby reduces parking prices it may in some cases increase vehicle trips and vehicle miles traveled.	Shared parking does not directly reduce vehicle travel if it substitutes for increased parking supply. To the degree that it increases the available supply of parking and reduces parking prices it can encourage automobile travel. To the degree that shared parking allows more clustered development it can encourage use of alternative modes.

Appendix F2—Menu of Travel Demand Management Measures, Alameda County TDM Program: Public or Private Organization Measures

TDM Program	Description	Primary Agency Responsible	City Implementation Mechanism	Recommended Application/ Context	% Trip Reduction	Factors	Source
Multimodal Infrastructure							
Bicycle sharing services	Bicycles are available to members for short-term rental and can be returned at any bike share station. Bike share may be offered in city neighborhoods, near transit hubs, or at major employment centers.	Cities or private bicycle sharing companies (usually at invitation of a city)		Urban; suburban downtown; transit station	Impacts depend on conditions	A survey of bikeshare users in four major cities (Minneapolis, Montreal, Toronto, and Washington DC) by Shaheen and Martin (2015) found that 25-52% reported reducing their automobile travel and 1.9-3.6% reported reducing their vehicle ownership. The impact depends on the larger bike network and bicycling conditions. This research does not state if the shift from automobile trips to bicycle trips is for commute or non-commute trips, nor does the research state at what time of day these trips occur, i.e., peak or non-peak trips.	Victoria Transport Policy Institute (2017), Public Bike Systems: Automated Bike Rentals for Short Utilitarian Trips, www.vtpi.org/tdm/tdm126.htm.
Enhanced transit service	Improve transit service to better serve potential riders and shift travel from driving trips.	Transit agencies, funded by cities, counties, TMAs, BIDs, regional agencies		Any	Impacts depend on the level and quality of improvements	The elasticity of transit use with respect to transit service frequency is about 0.4, which means that a 1.0% increase in service (measured by transit vehicle mileage or operating hours) increases average ridership by 0.4%. Not all persons will be shifting from auto to transit, so the relationship is not one to one.	Brian E. McCollom, Richard H. Pratt (2004), Transit Pricing and Fares – Traveler Response to Transportation System Changes, TCRB Report 95, Transportation Research Board (www.trb.org); available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_95c12.pdf.
High Occupancy Vehicle/Toll (HOV/HOT) lanes	Implement a system of express lanes for high-occupancy vehicles, transit, and/or people who pay a toll. This provides a time savings to people who commute by modes other than driving alone.	Highway districts, often led by counties or regional agencies		Freeways, any context	2% to 30%	Comsis (1993) and Turnbull, Levinson and Pratt (2006) find that HOV facilities can reduce vehicle trips on a particular roadway by 4-30%. Ewing (1993) estimates that HOV facilities can reduce peak-period vehicle trips on individual facilities by 2-10%, and up to 30% on very congested highways if HOV lanes are separated from general-purpose lanes by a barrier. Turnbull, Levinson and Pratt (2006) suggest that HOV highway lanes are most effective at reducing automobile use on congested highways to large employment centers in large urban areas with 25 or more buses per hour during peak periods, where transit provides time savings of at least 5 to 10 minutes per trip.	Comsis Corporation (1993), Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience, USDOT and Institute of Transportation Engineers (www.ite.org); available at www.bts.gov/ntl/DOCS/474.html. Katherine F. Turnbull, Herbert S. Levinson and Richard H. Pratt (2006), HOV Facilities – Traveler Response to Transportation System Changes, TCRB Report 95, Transportation Research Board (www.trb.org); available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_95c2.pdf.
Financial Incentives							
Transit "fare free" zones	Transit agency provides free rides in designated zone.	Transit agencies, can be initiated/funded by cities, transportation management associations (TMAs), business districts	Can be implemented directly by transit agency, or another organization can form a funding partnership with the transit agency	Urban or suburban downtowns	Not available	Impact of transit fare-free zones is highly context specific. Some cities have seen very large increases in transit ridership within free-fare zones.	Henry Grabar (2012), "What Really Happens When a City Makes Its Transit System Free?" available at http://www.citylab.com/work/2012/10/what-really-happens-when-city-makes-its-transit-system-free/3708/.

Appendix F3.1—Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Multimodal Accessibility and Transportation/Land Use Integration

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
Mode Share – Work Trips	• Percent of low-income households (<$25,000 per year) within 20-minute drive or 30-minute transit ride of activity center • Percent of low-income households (<$25,000 per year) within 0.5 miles of elementary school	• Evaluate scenarios • Track trends	American Community Survey		Multimodal	Performance Report
Mode Share – School Trips	• Daily hours spent walking or biking	• Evaluate scenarios • Track trends	• Household Travel Survey • Safe Routes to School surveys		Multimodal	Performance Report; Safe Routes to School Annual Report
Travel Time – Work Trips	• Average travel time to commute to work in minutes • Percent of workers with commute exceeding specified threshold (e.g., 1 hour)	• Track trends	American Community Survey		Affordable; Efficient	Performance Report
Land Use Approvals in PDAs	• New housing units within PDAs • New retail, office, and government square footage within PDAs	• Track trends	Land use database populated by local jurisdictions		Integrated Healthy Environment (Land Use)	Performance Report (if data is available); Priority Development Area Investment and Growth Strategy (PDA IGS)
Land Use Approvals Within Half Mile of Transit	• New housing units within half-mile of high-frequency transit • New retail, office, and government square footage within half-mile of high-frequency transit	• Track trends	Land use database populated by local jurisdictions		Integrated Healthy Environment (Land Use)	Performance Report (if data is available); PDA IGS

Appendix F3.2— Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Roadway

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
Travel Times	• Average travel time per trip in minutes for representative origin-destination pairs	• Evaluate scenarios • Track trends • Diagnose deficiencies • Prioritize investments • Perform before/after analysis	• Travel model	Most closely aligns to user experience and desired outcome	Connected	LOS Monitoring Report, if data is collected
Vehicle Throughput	• Average daily traffic • Peak-hour vehicle flows	• Evaluate scenarios • Track trends • Perform before/after analysis	• Caltrans Performance Monitoring System (PeMS) • Bay Area Toll Authority • Project-level data collection		Connected	Before/after study—Express Lanes
Person throughput	• Product of average daily traffic or peak-hour vehicle flows and average vehicle occupancy	• Evaluate scenarios • Track trends	• PeMS • Bay Area Toll Authority and vehicle occupancy counts or assumptions (could come from household travel surveys)		Efficient; Cost-effective	Before/after study—Express Lanes
Travel Speeds/ Level of Service	• Speeds of segments • Number of segments with speeds below threshold • LOS of segments • Congested speed based on average p.m. peak period	• Evaluate scenarios • Diagnose deficiencies • Track trends • Perform before/after analysis	Commercial speed data	Measures congestion intensity at particular locations (mobility) but does not directly measure ability to get to destinations (accessibility)	Efficient; Connected	LOS Monitoring Report; Before/after study—Express Lanes; Multimodal Arterial Plan
HOV or HOT Lane Travel Time Competitiveness	• Ratio of speed in HOV/HOT lane to general purpose lane	• Track trends • Diagnose deficiencies	• Floating car surveys • Bay Area Toll Authority • Commercial speed data in future • Alameda CTC express lane sensors		Efficient	Before/after study—Express Lanes; Express Lanes Monthly Operations Report
Person Hours of Delay	• Excess travel time due to facility operating below specified threshold	• Evaluate scenarios • Track trends	Commercial speed data and vehicle occupancy counts or assumptions	• Threshold for delay should be grounded in operational and economic considerations • Consideration should be given as to whether to normalize by motorists or traveling public	Efficient	Performance Report

Appendix F3.2—Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Roadway (continued)

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
Bottlenecks and Queues	• Percent of lane-miles operating below given speed	• Track trends • Diagnose deficiencies • Perform before/after analysis	• Commercial speed data • Alameda CTC express lane sensors		Efficient	Before/after study—Express Lanes
Pavement Condition Index (PCI)	• Average PCI • Percent of lane-miles that are poor, failed, and at-risk • Unmet maintenance needs over 28 years assuming current paving conditions • Unmet maintenance needs over 28 years to get local roads to certain PCI	• Evaluate blueprint scenarios • Track trends			Well-maintained	Performance Report; Multimodal Arterial Plan
Collisions and Rate	• Collisions • Collisions per million annual VMT	• Track trends • Diagnose deficiencies • Prioritize investments • Perform before/after analysis	Caltrans/California Highway Patrol Statewide Integrated Traffic Record System (SWITRS) database and PeMS		Safe	Performance Report; Multimodal Arterial Plan
Travel Reliability Index	• P.M. peak hour volume-to-capacity ratio	• Diagnose deficiencies • Perform before/after analysis	• Traffic count data from local jurisdictions and other agencies • Roadway capacity information from local jurisdictions	• Measures congestion intensity at particular locations (mobility) but does not directly measure ability to reach destinations • Measures reliability of travel through segments	Reliable	Multimodal Arterial Plan
ITS Infrastructure	• Level of ITS infrastructure	• Evaluate infrastructure ITS level	Data from local jurisdictions	• Measured using categorical classification of four-point index for level of ITS technology in a corridor	Connected; Efficient	Multimodal Arterial Plan

Appendix F3.3—Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Transit

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
Corridor Level Transit Speed	• Average travel time per trip in minutes for representative origin-destination pairs • Route-level average travel speed	• Evaluate scenarios • Track trends • Diagnose deficiencies • Prioritize investments • Perform before/after analysis	Transit agencies	• Most closely aligns to user experience • Should be assessed for representative travel markets	Connected (mobility, economic)	LOS Monitoring Report starting in 2018
Systemwide Travel Speed	• Average speed including delays from boarding/ alighting, signals, and traffic congestion • Average p.m. peak-hour transit travel speed	• Evaluate scenarios • Track trends • Diagnose deficiencies • Prioritize investments • Perform before/after analysis	Transit agencies		Connected (mobility, economic)	Performance Report; Countywide Transit Plan
Transit system Reliability	• Ratio of average p.m. peak-hour transit travel speed to non-peak-hour transit speed • Reduction in transit travel time (peak/off-peak)	• Evaluate scenarios • Track trends • Prioritize investments • Perform before/after analysis	Transit agencies		Connected (mobility, economic)	Countywide Transit Plan; Multimodal Arterial Plan
Ridership	• Annual boardings • Average weekday or weekend boardings • Per capita transit use • Per capita daily transit ridership • Passenger miles traveled • Percentage of intra-county passenger trips on transit	• Evaluate scenarios • Track trends • Prioritize investments • Perform before/after analysis	• National Transit Database • APC data • Alameda CTC model		Multimodal	Performance Report; Countywide Transit Plan
Service Utilization	• Boardings per revenue vehicle hour (RVH) or revenue vehicle mile (RVM)	• Evaluate scenarios • Track trends • Diagnose deficiencies • Prioritize investments	• National Transit Database • APC data	Can be measured at system- or line-level	Multimodal; Efficient	Performance Report
Load Factor	• Passenger miles traveled per RVM • Passenger miles per seat-miles	• Track trends	• National Transit Database	A basic measure of vehicle occupancy	Efficient; Reliable	Performance Report; Countywide Transit Plan

Appendix F3.3—Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Transit (continued)

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
On-Time Performance	• Percent of time arriving at stops within specified window of scheduled time	• Track trends • Diagnose deficiencies • Prioritize investments • Perform before/after analysis	Transit agencies	Can be assessed at system- or line-level	Reliable	Performance Report
Cost Effectiveness	• Operating cost per RVH or RVM • Operating cost per rider • Farebox recovery ratio	• Evaluate scenarios • Track trends	National Transit Database		Cost-effective	Performance Report
Service Interruptions	• Mean time between service delays (rail) • Average miles between revenue vehicle failures (bus)	• Track trends	National Transit Database		Well-maintained;Reliable	Performance Report
Transit Fleet Age	• Average age of fleet • Percent of useful life expended of vehicles • Cost of mid-life overhaul and/or replacement before plan horizon year	• Track trends • Prioritize investments	• National Transit Database		Well-maintained	Performance Report; Countywide Transit Plan
Public Transit Accessibility	• Percent households by income level within 0.25-mile of a bus route or 0.5-mile of a rail transit stop • Number of households/jobs within 0.5 miles of transit station • Number of Communities of Concern affected by proposed projects	• Evaluate scenarios • Perform before/after analysis	GIS analysis		Multimodal; Accessible; Equitable; Connected	Countywide Transportation Plan; Countywide Transit Plan

Appendix F3.4—Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Bicycling

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
Counts at Multiple Locations	• Total bicyclists counted in Alameda CTC count program (63 locations, designated time periods)	• Track trends	Alameda CTC Countywide Bicycle/Pedestrian Count Program	Annual count program collects one-day counts, so disaggregation below planning area level is not advisable	Multimodal	Performance Report
Collisions Involving Bicyclists	• Total collisions involving bicyclists • Injury and fatal collisions involving bicyclists	• Track trends • Diagnose deficiencies	SWITRS	Data typically 2 years out of date	Safe	Performance Report
Bicyclist Collision Severity	• Percent of fatal or severe injury collisions involving bicyclists	• Track trends • Diagnose deficiencies	SWITRS	Data typically 2 years out of date	Safe	Countywide Transit Plan; Multimodal Arterial Plan
Local Master Plan Adoption	• Number of jurisdictions with local master plan adopted within last 5 years	• Track trends	Local jurisdictions		Integrated; Connected	Countywide Transit Plan; Multimodal Arterial Plan
Miles of Network Built	• Miles of countywide facilities implemented • Percent of network mileage implemented •Miles of "innovative"facilities constructed (e.g., using design features recently adopted to Highway Design Manual)	• Track trends	• Alameda CTC GIS database • Local jurisdictions		Connected	Performance Report
Community Members Participating in Programs	• Community members participating in bicycle safety education • Community members counted at Bike to Work Day energizer stations • Number of schools with Safe Routes to Schools programs by type	• Track trends	• Countywide program progress reports • Safe Routes to Schools Annual Report		Connected; Accessible	Performance Report
Cyclist Comfort and Safety	• Level of traffic stress analysis	• Diagnose deficiencies • Prioritize investment	Field observation	Methodology that classifies facilities into one of four levels of Traffic Stress (LTS) indicating the comfort of cyclists' experience using the facility	Multimodal; Accessible; Safe	Multimodal Arterial Plan

Appendix F3.5—Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Pedestrian/Walking

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
Counts at Multiple Locations	• Total pedestrians counted in Alameda CTC count program (63 locations, designated time periods)	• Track trends	Alameda CTC Countywide Bicycle/Pedestrian Count Program	Annual count program collects one-day counts, so disaggregation below planning area level is not advisable	Multimodal	Performance Report
Collisions Involving Pedestrians	• Total collisions involving pedestrians • Injury and fatal collisions involving pedestrians	• Track trends • Diagnose deficiencies	Caltrans/California Highway Patrol SWITRS database	Data typically 2 years out of date	Safe	Performance Report
Pedestrian Collision Severity	• Percent of fatal or severe injury collisions involving pedestrians	• Track trends • Diagnose deficiencies	Caltrans/California Highway Patrol SWITRS database	Data typically 2 years out of date	Safe	Performance Report
Local Master Plan Adoption	• Number of jurisdictions with local master plan adopted within last 5 years	• Track trends	Local jurisdictions		Integrated; Connected	Performance Report
Number of Pedestrian Projects Complete	• Number of projects completed by type	• Track trends	Local jurisdictions		Connected	Performance Report
Pedestrian Comfort and Safety	• Pedestrian comfort index	• Diagnose deficiencies	Field observation	Index accounting for factors including sidewalk width, presence of buffer between sidewalk and roadway, land use context, roadway classification, average daily traffic, number of lanes, and speed limit	Multimodal; Safe	Multimodal Arterial Plan

Appendix F3.6—Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Goods Movement

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
GHG Emissions	• Tons of greenhouse gas (GHG) emissions from freight operations	• Prioritize investments • Evaluate scenarios	Travel model and Air Resource Board Emission Factor (EMFAC) model		Healthy Environment (air quality)	Goods Movement Plan; Rail Strategy Study
Air Quality	• Tons of PM2.5 emissions from freight operations • Tons of NOx emissions from freight operations	• Prioritize investments • Evaluate scenarios	Travel model and EMFAC model		Healthy Environment (air quality)	Goods Movement Plan; Rail Strategy Study
Equity	• Freight impacts such as light, noise pollution, safety, air pollution, and encroachment on specific, adjacent communities most affected	• Diagnose deficiencies • Prioritize investments	• GIS analysis (to identify communities) • Qualitative assessment and project-level studies (to determine impacts)		Equitable	Goods Movement Plan; Rail Strategy Study
Travel-time Delay	• Excess time due to travel below specified threshold (trucks) • Excess time due to congestion (rail, terminals)	• Diagnose deficiencies • Prioritize investments • Perform before/after analysis • Evaluate scenarios	• Commercial speed data • Caltrans PeMS • Travel model • Project-level studies (e.g., Project Study Reports, Environmental Impact Reports (EIRs))		Efficient (mobility)	Goods Movement Plan
Buffer Time Index	• Ratio of 95th percentile travel time to free-flow travel time for freight (truck) routes (freeway and some conventional highways)	• Prioritize investments	• Commercial speed data • Caltrans PeMS		Reliable (mobility)	Goods Movement Plan
Truck-involved Crashes	• Crashes involving trucks	• Diagnose deficiencies • Track trends	Caltrans/California Highway Patrol SWITRS database		Safe	Goods Movement Plan
Rail Collisions	• Crashes at at-grade rail crossing	• Diagnose deficiencies	Federal Rail Authority Office of Safety Analysis		Safe	Goods Movement Plan; Rail Strategy Study
Freight Infrastructure Conditions	• PCI on truck routes • Bridge condition rating	• Diagnose deficiencies • Evaluate scenarios	MTC StreetSaver		Well-maintained	Goods Movement Plan

Appendix F3.6—Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Goods Movement (continued)

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
Resiliency	• Addresses freight system vulnerability to major service disruptions due to major natural or other events	• Diagnose deficiencies	Qualitative assessment and project-level studies		Well-maintained	Goods Movement Plan
Use of Innovative Technology	• Use of ITS and other innovative technologies such as zero emissions	• Prioritize investments	Qualitative assessment		Efficient; Cost-effective	Goods Movement Plan
Multimodal Connectivity and Redundancy	• Freight route access from/to locations with significant freight activities	• Diagnose deficiencies • Prioritize investments	• GIS analysis and qualitative assessment		Connected (land use)	Goods Movement Plan; Rail Strategy Study
Compatibility with Land-use Decisions	• Locations and corridors with significant freight activities in proximity to non-compatible land uses currently and in the future	• Diagnose deficiencies • Prioritize investments	• GIS analysis and qualitative assessment		Integrated (land use)	Goods Movement Plan
Jobs and Economic Impact	• Jobs generated by project • Economic output generated by project • Jobs in goods movement- dependent industries	• Prioritize investments • Track trends • Perform before/after analysis • Evaluate scenarios	IMPLAN model		Cost-effective (economic)	Goods Movement Plan
Truck Route Accommodation Index	• Truck Route Accommodation Index	• Diagnose deficiencies • Prioritize investments	• Field observation • Data from jurisdictions	Index based on a three-point scoring system to measure curb-lane width and on-street parking in urban environments	Connected	Multimodal Arterial Plan

Appendix F3.7—Comprehensive Inventory of Performance Measures for Existing and Potential Applications: Environment, Equity, and Health

Measure/Concept	Metric	Applications	Data Sources	Considerations	CTP Goals (CMP Goals)	Report/Document (as applicable)
Activity Center Accessibility	• Percent of low-income households (<$25,000 per year) within 20-minute drive or 30-minute transit ride of activity center • Percent of low-income households (<$25,000 per year) within 0.5 miles of elementary school	• Evaluate scenarios	American Community Survey and GIS analysis	Best for less-frequent reporting as measure not highly dynamic	Equitable; Integrated; Connected (land use)	Countywide Transportation Plan
Physical Activity	• Daily hours spent walking or biking	• Evaluate scenarios • Track trends	• Travel model and off-model tools • California Health Interview Survey		Multimodal; Healthy environment	Countywide Transportation Plan
GHG Emissions	• Tons of daily GHG emissions (CO_2 equivalent) from passenger and freight transportation	• Evaluate scenarios	Travel model and Air Resource Board EMFAC model	Data limitations preclude annual monitoring	Healthy environment (air quality)	Countywide Transportation Plan
PM 2.6 Emissions	• Tons of daily particulate matter emissions from passenger and freight transportation	• Evaluate scenarios	Travel model and Air Resource Board EMFAC model	Data limitations preclude annual monitoring	Healthy environment (air quality)	Countywide Transportation Plan

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