BCAG SB 743 Implementation – Mitigation Strategies

Assessing Feasibility

BACKGROUND

This technical document summarizes our assessment of research related to vehicle miles of travel (VMT) reduction strategies associated with changing the built environment and implementing transportation demand management (TDM) measures. The purpose of this work was to compile a list of potential VMT reduction mitigation measures for use in Butte County given its small city, small town, and rural land use context. The specific approach was to build on the original research supporting VMT and greenhouse gas (GHG) mitigation contained in the *Quantifying Greenhouse Gas Mitigation Measures*, California Air Pollution Control Officers Association (CAPCOA), August 2010. New academic research published since 2010 was reviewed to update the CAPCOA strategies and then each strategy was evaluated for potential application in Butte County based on potential effectiveness given the land use and transportation context.

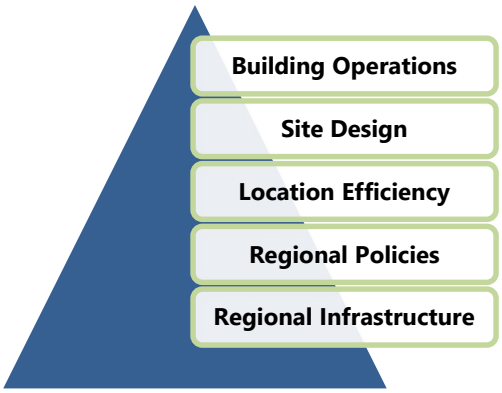
The CAPCOA report is a primary resource for quantifiable VMT and GHG reduction that can be applied at the project, community, and even regional level although most of the strategies are targeted for individual land use projects. The transportation component includes 50 strategies that can be implemented independently or in combination. The strategies cover a wide range of measures, from increasing transit frequency to implementing road pricing to encouraging location-efficient land uses, as well as more traditional TDM measures like ride-sharing programs and parking cash-out. For each strategy, the report provides a fact sheet that summarizes the available literature on the strategy and provides a methodology for quantifying the strategy's effectiveness. The table in Attachment A summarizes the overall evaluation of all the CAPCOA strategies including which strategies are best suited for implementation in Butte County. Note that the CAPCOA report is being updated and a new version is anticipated for release later in 2021 so some changes in Attachment A may be warranted after its release.

STRATEGY REVIEW

The matrix in Appendix A summarizes the overall evaluation findings and provides a complete list of VMT reduction mitigation strategies based on the latest available research. An important consideration for the effectiveness of the TDM strategies contained in the matrix is the appropriate scale of implementation. The strategies described in this memorandum include regional, city, and community-scale transportation infrastructure strategies (for example, expanding the transit or bicycle network) and project-level strategies (for example, building site TDM strategies such as parking pricing and transit pass subsidies). The largest reductions in VMT (and resulting emissions) derive from regional and city policies related to land use location efficiency and infrastructure investments that support transit, walking, and biking. While there are many measures related to site design and building operations that can influence VMT, they

typically have smaller effects that are often dependent on building tenants. Figure 1 presents a conceptual illustration of the relative importance of scale.

Figure 1: Transportation-Related GHG Reduction Measures



Source: Fehr & Peers, 2021

Of the 50 transportation-related strategies presented in the CAPCOA 2010 report, three are vehicle strategies unrelated to VMT reduction. The remaining 47 strategies are listed in Attachment A. Forty-one of these strategies are applicable at the building and site level. The other six are functions of, or depend on, site location and/or actions by local and regional agencies or funders. Table 1 summarizes the strategies according to the scope of implementation and the agents who would implement them.

Table 1: Summary of Transportation-Related CAPCOA Measures

Scope	Agents	CAPCOA Strategies
Building Operations	Employer, Manager	**26** from five CAPCOA strategy groups: • **3** from 3.2 Site Enhancements group • **3** from 3.3 Parking Pricing Availability group • **15** from 3.4 Commute Trip Reduction group • **2** from 3.5 Transit Access group • **3** from 3.7 Vehicle Operations group
Site Design	Owner, Architect	**15** from three strategy groups: • **6** from 3.1 Land Use group • **6** from 3.2 Site Enhancements group • **1** from 3.3 Parking group • **2** from 3.6 Road Access group
Location Efficiency	Developer, Local Agency	**3** shared with Regional and Local Policies
Alignment with Regional and Local Policies	Regional and Local Agencies	**3** shared with Location Efficiency

Source: Fehr & Peers, 2021

To identify the strategies appropriate for projects in Butte County, we followed the steps below to narrow the list.

1. Eliminated strategies for which the literature does not support a quantified and calculable reduction in VMT.
2. Eliminated strategies not appropriate outside a very urban land use context.
3. Separate strategies that apply at the community versus project scale.

This process produced 13 strategies out of the 47 strategies and are noted in the last column of Appendix A as those most likely to be effective in Butte County based on its rural, small town, or small city land use context. These strategies are described are briefly describe below, with CAPCOA strategy numbers in parentheses. Note that disruptive trends, including but not limited to, COVID-19 responses, transportation network companies (TNCs), autonomous vehicles (AVs), internet shopping, and micro-transit may affect the future effectiveness of these strategies.

Community-scale strategies

1. Provide pedestrian network improvements (3.2.1) – This strategy focuses on creating a pedestrian network within the project and connecting to nearby destinations. Projects in Butte County tend to be small so the emphasis of this strategy would likely be the construction of network improvements that connect the project site directly to nearby destinations. Alternatively, implementation could occur through an impact fee program (discussed in more detail below) or benefit/assessment district targeted to various areas in the County designated for improvements through local or regional plans. Implementation of this strategy may require regional or local agency coordination and may not be applicable for all individual land use development projects.

2. Provide traffic calming measures and low-stress bicycle network improvements (3.2.2) – This strategy combines the CAPCOA research focused on traffic calming with new research on providing a low-stress bicycle network. Traffic calming creates networks with low vehicle speeds and volumes that are more conducive to walking and bicycling. Building a low-stress bicycle network produces a similar outcome. One potential change in this strategy over time is that e-bikes (and e-scooters) could extend the effective range of travel on the bicycle network, which could enhance the effectiveness of this strategy. Implementation options are similar to strategy 2 above. Implementation of this strategy may require regional or local agency coordination and may not be applicable for all individual land use development projects.

3. Increase transit service frequency and speed (3.5.4) – This strategy focuses on improving transit service convenience and travel time competitiveness with driving. Given land use density in Butte County, this strategy may be limited to traditional commuter transit where trips can be pooled at the start and end locations or require new forms of demand-responsive

transit service. The demand-responsive service could be provided as subsidized trips by contracting to private TNCs or taxi companies. Alternatively, a public transit operator could provide the subsidized service but would need to improve on traditional cost effectiveness by relying on TNC ride-hailing technology, using smaller vehicles sized to demand, and flexible driver employment terms where drivers are paid by trip versus by hour. Implementation of this strategy would require regional or local agency implementation and/or substantial changes to current transit practices, and therefore would not likely be applicable to individual development projects.

4. Implement car-sharing programs (3.4.9) – This strategy reduces the need to own a vehicle or reduces the number of vehicles owned by a household by making it convenient to access a shared vehicle for those trips where vehicle use is essential. Note that implementation of this strategy would require regional or local agency implementation and coordination.

5. Provide coordinated school pools (3.4.10) – This strategy helps families share in the responsibilities of getting kids to school and back via carpooling, walking, biking, or riding the school bus together. Effectiveness of this program depends on the extent to which resident schoolchildren are already walking, biking, and riding the school bus to school.

Project-scale strategies

6. Increase diversity of land uses (3.1.3) – This strategy focuses on inclusion of mixed uses within projects or in consideration of the surrounding area to minimize vehicle travel in terms of both the number of trips and the length of those trips.

7. Provide ride-sharing program (3.4.3) – This strategy focuses on encouraging carpooling and vanpooling by project site/building tenants, which depends on the ultimate building tenants; this should be a factor in considering the potential VMT reduction.

8. Provide end of trip facilities (3.4.5) – This strategy involves providing end of trip bicycle facilities such as secure bicycle parking, lockers, and showers. Effectiveness tied to other supporting facilities and programs for bicycle use.

9. Implement subsidized or discounted transit program (3.4.4) – This strategy reduces the need to own a vehicle or reduces the number of vehicles owned by a household by incentivizing individuals to use transit for their daily commute. This strategy depends on the ultimate building tenants and may require monitoring. This strategy also relies on Butte Regional Transit continuing to provide similar or better service throughout the County, in terms of frequency and speed.

10. Encourage telecommuting and alternative work schedules (3.4.6) – This strategy relies on effective internet access and speeds to individual project sites/buildings to provide the

opportunity for telecommuting. The effectiveness of the strategy depends on the ultimate building tenants and the nature of work done by tenants' employees (can the work be done remotely in the first place?); two factors that should be considered for potential VMT reduction. Effectiveness may also be limited in more rural areas of the County with limited broadband internet access.

11. Implement employer marketing of commute alternatives (3.4.7) – This strategy increases the effectiveness of commute trip reduction programs by requiring employers to market them directly to their employees. This strategy depends on the ultimate building tenants and may require monitoring.

12. Provide employer-sponsored vanpool/shuttle (3.4.11) – Employer-sponsored vanpools and shuttles provide a shared commute alternative to driving alone. The effectiveness of this strategy depends on the ultimate building tenants and may require monitoring.

13. Implement parking management (3.3.1 and 3.3.2) – Parking management strategies focus on the management of parking to influence vehicle travel. Free and ubiquitous parking supply tends to increase vehicle use while reducing parking supply and pricing spaces can help reduce vehicle travel. A reduction in parking supply can also be used to incentivize infill development and higher density development by reducing the cost of building parking spaces. These strategies may be less effective in suburban and rural settings such as Butte County but will depend on the specific project site and the surrounding parking supply.

Of these strategies, the most effective are those that would be implemented at the community scale and would likely require a program approach to implementation, such as an impact fee program, mitigation bank, or mitigation exchange. These approaches are discussed below. Project site mitigation effectiveness is more limited given the small number of travelers involved and the land use context.

LIMITATIONS OF QUANTIFICATION

To be effective mitigation measures, TDM strategies must have sufficient evidence to quantify the level of VMT reduction that a strategy could achieve for a given project site. In general, the TDM strategies can be quantified using CAPCOA calculation methodologies but there are some important limitations for project site applications and combining strategies as explained below.

Project Site Applications

The density and mix of surrounding land uses, plus the quality of available transit service, are all examples of land use context factors that influence vehicle trip making. Therefore, the CAPCOA methodology identifies VMT reduction maximums based on community types tied to land use context. The caps are applied at each step of the VMT reduction calculation (at the strategy scale, the combined strategy scale, and the global scale). However, these caps are not based on research related to the effectiveness of VMT reduction strategies in different land use contexts. Instead, the percentages were derived from a limited comparison of aggregate citywide VMT performance for Sebastopol, San Rafael, and San Mateo, where

VMT performance ranged from 0 to 17 percent below the statewide VMT/capita average based on data collected prior to 2002. Little to no evidence exists about the long-term performance of similar TDM strategies in different land use contexts. Therefore, VMT reductions from TDM strategies have limited confidence.

Combining VMT Reduction Strategies

Each of the CAPCOA TDM strategies can be combined with others to increase the effectiveness of VMT mitigation; however, the interaction between the various strategies is complex and sometimes counterintuitive. Generally, with each additional measure implemented, a VMT reduction is achieved, but the incremental benefit of VMT reduction may diminish. To quantify the VMT reduction that results from combining strategies, the formula below can be applied absent additional knowledge or information:

$$Total\ VMT\ Reduction = (1 - P_a) * (1 - P_b) * (1 - P_c) * \ldots$$

where

$$P_x = percent\ reduction\ of\ each\ VMT\ reduction\ strategy$$

This adjustment methodology is a mathematical approach to dampening the potential effectiveness and is not supported by research related to the actual effectiveness of combined strategies. The intent of including this formula is to provide a mechanism for dampening to minimize the potential to overstate the VMT reduction effectiveness. Analysts should consider the available substantial evidence at the time a study is prepared to determine the most appropriate approach for California Environmental Quality Act (CEQA) review.

LIMITATIONS FOR IMPLEMENTATION

Physical project site TDM strategies often involve increasing land use density, changing the mix of uses, or altering the transportation network. However, a potential limitation of these physical design changes is that they may result in a project that no longer resembles the original applicant submittal. CEQA is intended to disclose the potential impacts of a project and mitigate those impacts but has limitations with regards to using mitigation to fundamentally change the project. Therefore, these strategies may result in an inconsistency with the project description when applied on an ad hoc basis.

Another common strategy is to add a TDM program to the project as a condition of approval. While evidence exists that TDM programs can reduce VMT, their success depends on the performance of future building tenants that can change over time. Hence, an effective TDM mitigation program will require ongoing monitoring and adjustment to ensure long-term VMT reduction is achieved. The cost to provide this monitoring may not be feasible for all projects. Without monitoring to ensure effectiveness, significant VMT impacts may remain significant and unavoidable.

ADDRESSING LIMITATIONS

In response to the limitations of focusing exclusively on project site TDM strategies, new mitigation concepts are emerging that cover larger areas and rely on region- or city-scale programs to achieve VMT reductions. These program-based concepts are outlined below. As with all VMT mitigation, these

programs require substantial evidence to demonstrate that the projects included in the programs would achieve the expected VMT reductions. Additionally, the discretionary action to adopt the program may require CEQA review.

- **VMT Impact Fee Program** – This concept resembles a traditional impact fee program in compliance with the mitigation fee act and uses VMT as a metric. The nexus for the fee program would be a VMT reduction goal consistent with the CEQA threshold established by a lead agency for SB 743 purposes. The main difference from a fee program based on a metric such as vehicle LOS is that the VMT reduction nexus results in a capital improvement program (CIP) consisting largely of transit, bicycle, and pedestrian projects. These types of fee programs are time consuming to develop, monitor, and maintain but are recognized as an acceptable form of CEQA mitigation if they can demonstrate that the CIP projects will be fully funded and implemented. To date, the Cities of Los Angeles, Orange, and San Diego have adopted VMT impact fee programs.[1]

- **VMT Exchanges** – This concept (along with VMT banks) borrows mitigation approaches from other environmental analysis such as wetlands. The concept relies on a developer agreeing to implement a predetermined VMT-reducing project or proposing a new one in exchange for the ability to develop a VMT-generating project. The mitigation projects may or may not be located near the developer's project site. The concept requires a facilitating entity (such as the lead agency) to match the VMT generator (the development project) with the VMT-reducing project and ensure through substantial evidence that the VMT reduction is valid. Another requirement is a determination of the necessary time period to demonstrate a VMT reduction. For example, how many years of VMT reduction are required to declare a VMT impact less than significant? A final requirement is that mitigation projects would not have otherwise occurred without the Exchange, which is a condition known as "additionality." No exchanges have been created yet but the City of Los Angeles in collaboration with Metro and the Southern California Association of Governments (SCAG) is evaluating a pilot concept based on developers purchasing student transit passes from Metro.

- **VMT Banks** – This concept attempts to create a monetary value for VMT reduction (for example, credits) such that a developer could purchase VMT reduction credits. The money exchanged for credits could be applied to local, regional, or state level VMT reduction projects or actions. This program is more complicated than an exchange and would require more time and effort to set up and implement. It would include the requirements above for an exchange, such as mitigation time periods and additionality determinations, while also tackling the unique challenge of estimating how much VMT reduction is associated with each credit and whether this value would change over time based on mitigation performance and new mitigation offerings. ." No banks have been created yet but the City of Los Angeles pilot noted above is also considering a bank option.

[1] Copies of the nexus studies are available for review by contacting r.milam@fehrandpeers.com.

Table 2 compares the pros and cons of these three programs. Although implementation of these programs would require an upfront cost, they have several advantages over project site TDM strategies.

- CEQA streamlining – These programs provide a funding mechanism for project mitigation and may require less project-site monitoring to demonstrate that significant impacts are reduced to a less-than-significant level. Additionally, projects could be screened from completing a quantitative VMT analysis; or, if a quantitative VMT analysis is required, the cost would be somewhat less than the cost for analyzing LOS impacts.

- Greater VMT reduction potential – Since these programs coordinate citywide land use and transportation projects, they have the potential to result in greater VMT reduction potential than site-level TDM strategies applied on a project-by-project basis. Additionally, these programs expand the amount of feasible mitigation for reducing VMT impacts. A wider range of feasible VMT reduction measures may reveal some measures that can reduce VMT more cost-effectively than site-level mitigations alone.

- Legal compliance – The VMT reduction programs can help build a case for a nexus between a VMT impact and funding for capital improvement programs.

However, program-based approaches also have at least one disadvantage: they may lead to increased development costs by introducing additional feasible mitigation measures. Adding impact mitigation costs to suburban and rural housing projects may be counter to lead agency land use diversity and adequate/affordable housing goals.

Table 2: VMT Mitigation Program Type Comparison

Program Type	Pros	Cons
Impact Fee Program	• Common and accepted practice • Accepted for CEQA mitigation • Adds certainty to development costs • Allows for regional scale mitigation projects • Increases potential VMT reduction compared to project site mitigation only	• Time consuming and expensive to develop and maintain • Requires clear nexus between CIP projects and VMT reduction • Increases mitigation costs for developers because it increases feasible mitigation options
Mitigation Exchange	• Limited complexity • Reduced nexus obligation • Expands mitigation to include costs for programs, operations, and maintenance • Allows for regional scale mitigation projects • Allows for mitigation projects to be in other jurisdictions • Increases potential VMT reduction compared to project site mitigation only	• Requires additionality • Potential for mismatch between mitigation need (project site) and mitigation project location • Increases mitigation costs for developers because it increases feasible mitigation options • Unknown timeframe for mitigation life
Mitigation Bank	• Adds certainty to development costs • Allows for regional scale projects • Allows for mitigation projects to be in other jurisdictions • Allows regional or state transfers • Expands mitigation options to include costs for programs, operations, and maintenance • Increases potential VMT reduction compared to project site mitigation only	• Requires additionality • Time consuming and expensive to develop and maintain • Requires strong nexus • Political difficulty distributing mitigation dollars/projects • Increases mitigation costs for developers because it increases feasible mitigation options • Unknown timeframe for mitigation life

Source: Fehr & Peers, 2021

Appendix A

CAPCOA Category	CAPCOA #	CAPCOA Strategy	CAPCOA Reduction	Strength of Evidence for CEQA	Applicable for Individual Projects?	New Information Since CAPCOA Was Published in 2010			Consider for Butte County Mitigation?
						New information	Updated VMT reduction (1)	Literature or Evidence Cited	
Land Use/Location	3.1.1	LUT-1 Increase Density	0.8% - 30% VMT reduction due to increase in density	Adequate	Yes - however, the project must increase residential or employment density by at least 10%.	Increasing residential density is associated with lower VMT per capita. Increased residential density in areas with high jobs access may have a greater VMT change than increases in regions with lower jobs access. The range of reductions is based on a range of elasticities from -0.04 to -0.22. The low end of the reductions represents a -0.04 elasticity of demand in response to a 10% increase in residential units or employment density and a -0.22 elasticity in response to 50% increase to residential/employment density.	0.4% -10.75%	Primary sources: Boarnet, M. and Handy, S. (2014). Impacts of Residential Density on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm Secondary source: Stevens, M. (2017). Does Compact Development Make People Drive Less? Journal of the American Planning Association, 83(1), 7-18.	No - Applicable only when density exceeds 7 dwelling units per acre
Land Use/Location	3.1.2	LUT-2 Increase Location Efficiency	10% - 65% VMT reduction due to increase in location efficiency	Adequate	No	Rarely feasible to change the location of an individual land use project. May be applicable for land use plans at the city or larger area.	Elasticity -0.05 to -0.25 VMT percent reduction per 1 percent increase in regional accessibility	Primary source: Handy, S. et al. (2013) Impacts of Regional Accessibility Based on a Review of the Empirical Literature - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm	No - Not applicable to individual land use projects
Land Use/ Location	3.1.3	LUT-3 Increase Diversity of Urban and Suburban Developments	9%-30% VMT reduction due to mixing land uses within a single development	Adequate	Yes	1] VMT reduction due to mix of land uses within a single development. Mixing land uses within a single development can decrease VMT (and resulting GHG emissions), since building users do not need to drive to meet all of their needs. 2] Reduction in VMT due to regional change in entropy index of diversity. Providing a mix of land uses within a single neighborhood can decrease VMT (and resulting GHG emissions), since trips between land use types are shorter and may be accommodated by non-auto modes of transport.	1] 0%-12% 2] 0.3%-4%	1] Ewing, R. and Cervero, R. (2010). Travel and the Built Environment - A Meta-Analysis. Journal of the American Planning Association,76(3),265-294. Cited in California Air Pollution Control Officers Association. (2010).Quantifying Greenhouse Gas Mitigation Measures. Retrieved from: http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf 2] Zhang, Wengia et al. "Short- and Long-Term Effects of Land Use on Reducing Personal Vehicle Miles of Travel."	Yes

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Land Use/Location	3.1.4	LUT-4 Increase Destination Accessibility	6.7%-20% VMT reduction due to decrease in distance to major job center or downtown	Adequate	Yes	Reduction in VMT due to increased regional accessibility (jobs gravity). Locating new development in areas with good access to destinations reduces VMT by reducing trip lengths and making walking, biking, and transit trips more feasible. Destination accessibility is measured in terms of the number of jobs (or other attractions) reachable within a given travel time, which tends to be highest at central locations and lowest at peripheral ones. Rarely feasible to change the location of an indivdiual land use project. May be applicable for land use plans at the city or larger area.	0.5%-12%	Primary sources: Handy, S. et al. (2014). Impacts of Network Connectivity on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm Handy, S. et al. (2013). Impacts of Regional Accessibility on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm Secondary source: Holtzclaw, et al. (2002.) Location Efficiency: Neighborhood and Socioeconomic Characteristics Determine Auto Ownership and Use – Studies in Chicago, Los Angeles, and Chicago. Transportation Planning and Technology, Vol. 25, pp. 1–27.	No - Requires relocating the project

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Land Use/ Location	3.1.5	LUT-5 Increase Transit Accessibility	0.5%-24.6% reduce in VMT due to locating a project near high-quality transit	Adequate	Yes - the project must include the TOD design features.	1] VMT reduction when transit station is provided within 1/2 mile of development (compared to VMT for sites located outside 1/2 mile radius of transit). Locating high density development within 1/2 mile of transit will facilitate the use of transit by people traveling to or from the Project site. The use of transit results in a mode shift and therefore reduced VMT. 2] Reduction in vehicle trips due to implementing TOD. A project with a residential/commercial center designed around a rail or bus station, is called a transit-oriented development (TOD).	1] 0%-5.8% 2] 0%-7.3%	1] Lund, H. et al. (2004). Travel Characteristics of Transit-Oriented Development in California. Oakland, CA: Bay Area Rapid Transit District, Metropolitan Transportation Commission, and Caltrans. 2] Zamir, K. R. et al. (2014). Effects of Transit-Oriented Development on Trip Generation, Distribution, and Mode Share in Washington, D.C., and Baltimore, Maryland. Transportation Research Record: Journal of the Transportation Research Board. 2413, 45–53. DOI: 10.3141/2413-05	No - Applicable only in urban contexts with high quality transit
Land Use/ Location	3.1.6	LUT-6 Integrate Affordable and Below Market Rate Housing	0.04%-1.20% reduction in VMT for making up to 30% of housing units BMR	Weak - Should only be used where supported by local data on affordable housing trip generation.	Potentially yes - the use of this strategy would need to be supported by local data.	Observed trip generation indicates substantial local and regional variation in trip making behavior at affordable housing sites. Recommend use of ITE rates or local data for senior housing.	N/A	"Draft Memorandum: Infill and Complete Streets Study, Task 2.1: Local Trip Generation Study." *Measuring the Miles: Developing new metrics for vehicle travel in LA.* City of Los Angeles, April 19, 2017.	No - Lack of evidence
Land Use/ Location	3.1.7	LUT-7 - Orient Project Toward Non-Auto Corridor	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Land Use/ Location	3.1.8	LUT-8 Locate Project Near Bike Path/Bike Lane	Insufficient evidence for CEQA mitigation						No - Lack of evidence

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Land Use/ Location	3.1.9	LUT-9 Improve Design of Development	3.0% - 21.3% reduction in VMT due to increasing intersection density vs. typical ITE suburban development	Adequate	Potentially yes - scale of the project is key factor.	No update to CAPCOA literature; advise applying CAPCOA measure only to large developments with significant internal street structure.	Same	N/A	No - Applicable only in specific contexts
Neighborhood Site Enhancements	3.2.1	SDT-1 Provide Pedestrian Network Improvements	0%-2% reduction in VMT for creating a connected pedestrian network within the development and connecting to nearby destinations	Adequate	No - Current research supports city and neighborhood level VMT reductions only.	VMT reduction due to provision of complete pedestrian networks. Only applies if located in an area that may be prone to having a less robust sidewalk network.	0.5%-5.7%	Handy, S. et al. (2014). Impacts of Pedestrian Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm	Yes
Neighborhood Site Enhancements	3.2.2	SDT-2 Provide Traffic Calming Measures	0.25%-1% VMT reduction due to traffic calming on streets within and around the development	Adequate	Potentially yes - Research includes numerous land use and network conditions that must be met.	Reduction in VMT due to expansion of bike networks in urban areas. Strategy only applies to bicycle facilities that provide a dedicated lane for bicyclists or a completely separated right-of-way for bicycles and pedestrians.	0%-1.7%	Zahabi, S. et al. (2016). Exploring the link between the neighborhood typologies, bicycle infrastructure and commuting cycling over time and the potential impact on commuter GHG emissions. Transportation Research Part D: Transport and Environment. 47, 89-103.	Yes
Neighborhood Site Enhancements	3.2.3	SDT-3 Implement an NEV Network	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Neighborhood Site Enhancements	3.2.4	SDT-4 Urban Non Motorized Zones	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Neighborhood Site Enhancements	3.2.5	SDT-5 Incorporate Bike Lane Street Design (on-site)	Insufficient evidence for CEQA mitigation						No - Lack of evidence

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Neighborhood Site Enhancements	3.2.6	SDT-6 Provide Bike Parking in Non-Residential Projects	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Neighborhood Site Enhancements	3.2.7	SDT-7 Provide Bike Parking in Multi-Unit Residential Projects	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Neighborhood Site Enhancements	3.2.8	SDT-8 Provide EV Parking	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Neighborhood Site Enhancements	3.2.9	SDT-9 Dedicate Lane for Bike Trails	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Parking Pricing	3.3.1	PDT-1 Limit Parking Supply	5%-12.5% VMT reduction in response to reduced parking supply vs. ITE parking generation rate	Weak - not recommended in current form. See new evidence.	Yes	VMT reduction occurs in residential areas where convenience of transit use is high and where nearby parking is also limited.	0-13.7%	California Department of Transportation (Caltrans). 2012. California Household Travel Survey (CHTS). Available: https://www.nrel.gov/transportation/secure-transportation-data/tsdccalifornia-travel-survey.html. Accessed: January 2021 Chatman, D. 2013. Does TOD need the T? On the importance of factors other than rail access." Journal of the American Planning Association 79, no. 1. Available: https://trid.trb.org/view/1243004 . Accessed: January 2021.	No - Applicable only in specific contexts

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						New information	Updated VMT reduction (1)	Literature or Evidence Cited	
Parking Pricing	3.3.2	PDT-2 Unbundle Parking Costs from Property Cost	2.6% -13% VMT reduction due to decreased vehicle ownership rates	Adequate - conditional on the agency not requiring parking minimums and pricing/managing on-street parking (i.e., residential parking permit districts, etc.).	Yes - however, the project must be in a location that does not require parking minimums and has priced or permitting on-street parking.	Reduction in VMT, primarily for residential uses, based on range of elasticities for vehicle ownership in response to increased residential parking fees. Does not account for self-selection. Only applies if the city does not require parking minimums and if on-street parking is priced and managed (i.e., residential parking permit districts).	0-13.3%	Victoria Transport Policy Institute (2020). Parking Requirement Impacts on Housing Affordability. Retrieved January 2021 from: http://www.vtpi.org/park-hou.pdf.	Yes
Parking Pricing	3.3.3	PDT-3 Implement Market Price Public Parking	2.8%-5.5% VMT reduction due to "park once" behavior and disincentive to driving	Adequate	Yes - however, the VMT reductions would only apply to visitor or customer trips.	Implement a pricing strategy for parking by pricing all central business district/employment center/retail center on-street parking. It will be priced to encourage "park once" behavior. The benefit of this measure above that of paid parking at the project only is that it deters parking spillover from project supplied parking to other public parking nearby, which undermine the vehicle miles traveled (VMT) benefits of project pricing. It may also generate sufficient area-wide mode shifts to justify increased transit service to the area.	0-30.0%	Pierce, G., Shoup, D. 2013. Getting the Prices Right: An Evaluation of Pricing Parking by Demand in San Francisco. Journal of the American Planning Association, 79(1), 67-81. May. Available: https://www.tandfonline.com/doi/pdf/10.1080/01944363.2013.787307?needAccess=true. Accessed: January 2021.	No - Applicable only in specific contexts
Parking Pricing	3.3.4	PDT-4 Require Residential Area Parking Permits	Insufficient evidence for CEQA mitigation						No - Lack of evidence

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Commute Trip Reduction	3.4.1	TRT-1 Implement CTR Program - Voluntary	1.0%-6.2% commute VMT reduction due to employer-based mode shift program	Adequate - Effectiveness is building/tenant specific. Do not use with "TRT-2 Implement CTR Program - Required Implementation/ Monitoring" or with CAPCOA strategies TRT-3.4.3 through TRT-3.4.9.	Yes - however, the effectiveness of a voluntary CTR program would be building tenant specific and may require monitoring to evaluate the program's effectiveness.	Reduction in vehicle trips in response to employer-led TDM programs. The CTR program should include all of the following to apply the effectiveness reported by the literature: • Carpooling encouragement • Ride-matching assistance • Preferential carpool parking • Flexible work schedules for carpools • Half time transportation coordinator • Vanpool assistance • Bicycle end-trip facilities (parking, showers and lockers)	1.0%-6.0%	Boarnet, M. et al. (2014). Impacts of Employer-Based Trip Reduction Programs and Vanpools on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm	No - Applicable only in urban contexts with substantial congestion.
Commute Trip Reduction	3.4.2	TRT-2 Implement CTR Program - Required Implementation/ Monitoring	4.2%-21.0% commute VMT reduction due to employer-based mode shift program with required monitoring and reporting	Adequate - Effectiveness is building/tenant specific. Do not use with "TRT-1 Implement CTR Program - Voluntary" or with CAPCOA strategies TRT-3.4.3 through TRT-3.4.9.	Yes - however, the effectiveness of a CTR program would be building tenant specific and may require monitoring to evaluate the program's effectiveness.	Limited evidence available. Anecdotal evidence shows high investment produces high VMT/vehicle trip reductions at employment sites with monitoring requirements and specific targets.	Same	Nelson/Nygaard (2008). South San Francisco Mode Share and Parking Report for Genentech, Inc.(p. 8) Cited in: California Air Pollution Control Officers Association. (2010). Quantifying Greenhouse Gas Mitigation Measures. Retrieved from: http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf	No - Applicable only in urban contexts with substantial congestion.

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Commute Trip Reduction	3.4.3	TRT-3 Provide Ride-Sharing Programs	1%-15% commute VMT reduction due to employer ride share coordination and facilities	Adequate - Effectiveness is building/tenant specific. Do not use with "TRT-1 Implement CTR Program - Voluntary" or "TRT-2 Implement CTR Program - Required Implementation/ Monitoring."	Yes - however, the effectiveness of the ride-sharing programs is building tenant specific and may require monitoring to evaluate the program's effectiveness.	Commute vehicle trips reduction due to employer ride-sharing programs. Promote ride-sharing programs through a multi-faceted approach such as: • Designating a certain percentage of parking spaces for ride sharing vehicles • Designating adequate passenger loading and unloading and waiting areas for ride-sharing vehicles • Providing an app or website for coordinating rides	2.5%-8.3%	Victoria Transport Policy Institute. (2015). Ridesharing: Carpooling and Vanpooling. Online TDM Encyclopedia. Retrieved from: http://vtpi.org/tdm/tdm34.htm	Yes
Commute Trip Reduction	3.4.4	TRT-4 Implement Subsidized or Discounted Transit Program	0.3%-20% commute VMT reduction due to transit subsidy of up to $6/day	Adequate - Effectiveness is building/tenant specific. Do not use with "TRT-1 Implement CTR Program - Voluntary" or "TRT-2 Implement CTR Program - Required Implementation/ Monitoring."	Yes	1] Reduction in vehicle trips in response to reduced cost of transit use, assuming that 10-50% of new bus trips replace vehicle trips; 2] Reduction in commute trip VMT due to employee benefits that include transit 3] Reduction in all vehicle trips due to reduced transit fares system-wide, assuming 25% of new transit trips would have been vehicle trips.	1] 0.3%-14% 2] 0-16% 3] 0.1% to 6.9%	1] Victoria Transport Policy Institute. (2017). Understanding Transport Demands and Elasticities. Online TDM Encyclopedia. Retrieved from: http://www.vtpi.org/tdm/tdm11.htm 2] Carolina, P. et al. (2016). Do Employee Commuter Benefits Increase Transit Ridership? Evidence rom the NY-NJ Region. Washington, DC: Transportation Research Board, 96th Annual Meeting. 3] Handy, S. et al. (2013). Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm	Yes

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Commute Trip Reduction	3.4.5	TRT-5 Provide End of Trip Facilities	Limited effect if implemented alone. Preferred grouping with TRT-1 and TRT-2 to reduce commute VMT.	Adequate - Effectiveness is building/tenant specific.	Yes	End of trip facilities are associated with higher levels of bicycling to work compared to locations with no facilities.	0.1-4.4%	Buehler, R. 2012. Determinants of bicycle commuting in the Washington, DC region: The role bicycle parking, cyclist showers, and free car parking at work. Transportation Research Part D, 17, 525– 531. Available: http://www.pedbikeinfo.org/cms/downloads/DeterminantsofBicycleCommuting.pdf. Accessed: January 2021	Yes
Commute Trip Reduction	3.4.6	TRT-6 Encourage Telecommuting and Alternative Work Schedules	0.07%-5.5% commute VMT reduction due to reduced commute trips	Adequate - Effectiveness is building/tenant specific. Do not use with "TRT-1 Implement CTR Program - Voluntary" or "TRT-2 Implement CTR Program - Required Implementation/ Monitoring."	Yes	VMT reduction due to adoption of telecommuting. Alternative work schedules could take the form of staggered starting times, flexible schedules, or compressed work weeks.	0.2%-4.5%	Handy, S. et al. (2013). Policy Brief on the Impacts of Telecommuting Based on a Review of the Empirical Literature. California Air Resources Board. Retrieved from: https://www.arb.ca.gov/cc/sb375/policies/telecommuting/telecommuting_brief120313.pdf	Yes

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Commute Trip Reduction	3.4.7	1] TRT-7 Implement CTR Marketing 2] Launch Targeted Behavioral Interventions	0.8%-4.0% commute VMT reduction due to employer marketing of alternatives	Adequate - Effectiveness is building/tenant specific. Do not use with "TRT-1 Implement CTR Program - Voluntary" or "TRT-2 Implement CTR Program - Required Implementation/ Monitoring."	Yes	1] Vehicle trips reduction due to CTR marketing; 2] Reduction in VMT from institutional trips due to targeted behavioral intervention programs	1] 0.9% to 26% 2] 1%-6%	1] Pratt, Dick. Personal communication regarding the Draft of TCRP 95 Traveler Response to Transportation System Changes – Chapter 19 Employer and Institutional TDM Strategies. Transit Cooperative Research Program. Cited in California Air Pollution Control Officers Association. (2010).Quantifying Greenhouse Gas Mitigation Measures. Retrieved from: http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf 2] Brown, A. and Ralph, K. (2017.) "The Right Time and Place to Change Travel Behavior: An Experimental Study." Washington, DC: Transportation Research Board, 2017 Annual Meeting. Retrieved from: https://trid.trb.org/view.aspx?id=1437253	Yes
Commute Trip Reduction	3.4.8	TRT-8 Implement Preferential Parking Permit Program	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Commute Trip Reduction	3.4.9	TRT-9 Implement Car-Sharing Program	0.4% - 0.7% VMT reduction due to lower vehicle ownership rates and general shift to non-driving modes	Adequate	No - this strategy would require local and/or regional agency coordination to implement.	Vehicle trip reduction due to car-sharing programs; reduction assumes 1%-5% penetration rate. Implementing car-sharing programs allows people to have on-demand access to a shared fleet of vehicles on an as-needed basis, reducing need to own a vehicle. This contributes to greater use of transit and active transportation for more routine trips.	0.3%-1.6%	Lovejoy, K. et al. (2013). Impacts of Carsharing on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm.	Yes

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Commute Trip Reduction	3.4.10	TRT-10 Implement a School Pool Program	7.2%-15.8% reduction in school VMT due to school pool implementation	Adequate - School VMT only.	Not applicable, unless if the project being evaluated is a school.	Limited new evidence available, not conclusive	Same	Transportation Demand Management Institute of the Association for Commuter Transportation. TDM Case Studies and Commuter Testimonials. Prepared for the US EPA. 1997. (p. 10, 36-38) WayToGo 2015 Annual Report. Accessed on March 12, 2017 from http://www.waytogo.org/sites/default/files/attachments/waytogo-annual-report-2015.pdf	Yes
Commute Trip Reduction	3.4.11	TRT-11 Provide Employer-Sponsored Vanpool/Shuttle	0.3%-13.4% commute VMT reduction due to employer-sponsored vanpool and/or shuttle service	Adequate - Effectiveness is building/tenant specific.	Yes	1] Reduction in commute vehicle trips due to implementing employer-sponsored vanpool and shuttle programs; 2] Reduction in commute vehicle trips due to vanpool incentive programs; 3] Reduction in commute vehicle trips due to employer shuttle programs	1] 0.5%-5.0% 2] 0.3%-7.4% 3] 1.4%-6.8%	1] Concas, Sisinnio, Winters, Philip, Wambalaba, Francis, (2005). Fare Pricing Elasticity, Subsidies, and Demand for Vanpool Services. Transportation Research Record: Journal of the Transportation Research Board, 1924, pp 215-223. 2] Victoria Transport Policy Institute. (2015). Ridesharing: Carpooling and Vanpooling. Online TDM Encyclopedia. Retrieved from: http://vtpi.org/tdm/tdm34.htm 3] ICF. (2014). GHG Impacts for Commuter Shuttles Pilot Program.	Yes
Commute Trip Reduction	3.4.12	TRT-12 Implement Bike-Sharing Programs	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Commute Trip Reduction	3.4.13	TRT-13 Implement School Bus Program	38%-63% reduction in school VMT due to school bus service implementation	Adequate - School VMT only.	Not applicable, unless the project being evaluated is a school.	VMT reduction for school trips based on data beyond a single school district. School district boundaries are also a factor to consider. VMT reduction does not appear to be a factor that was considered in a select review of CA boundaries.	5%-30%	Wilson, E., et al. (2007). The implications of school choice on travel behavior and environmental emissions. Transportation Research Part D: Transport and Environment 12(2007), 506-518.	No - Not applicable to individual land use projects

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Commute Trip Reduction	3.4.14	TRT-14 Price Workplace Parking	0.1%-19.7% commute VMT reduction due to mode shift	Adequate - Effectiveness is building/tenant specific.	Yes	Reduction in commute vehicle trips due to priced workplace parking; effectiveness depends on availability of alternative modes. Workplace parking pricing may include: explicitly charging for parking, implementing above market rate pricing, validating parking only for invited guests, not providing employee parking and transportation allowances, and educating employees about available alternatives.	0.5%-14%	Primary sources: Concas, S. and Nayak, N. (2012), A Meta-Analysis of Parking Price Elasticity. Washington, DC: Transportation Research Board, 2012 Annual Meeting. Dale, S. et al. (2016). Evaluating the Impact of a Workplace Parking Levy on Local Traffic Congestion: The Case of Nottingham UK. Washington, DC: Transportation Research Board, 96th Annual Meeting. Secondary sources: Victoria Transport Policy Institute. (2017). Understanding Transport Demands and Elasticities. Online TDM Encyclopedia. Retrieved from: http://www.vtpi.org/tdm/tdm11.htm Spears, S. et al. (2014). Impacts of Parking Pricing on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm	No - Applicable only in specific contexts
Commute Trip Reduction	3.4.15	TRT-15 Employee Parking Cash-Out	0.6%-7.7% commute VMT reduction due to implementing employee parking cash-out	Weak - Effectiveness is building/tenant specific. Research data is over 10 years old (1997).	Yes	Shoup case studies indicate a reduction in commute vehicle trips due to implementing cash-out without implementing other trip-reduction strategies.	3%-7.7%	Shoup, D. (1997). Evaluating the Effects of Cashing Out Employer-Paid Parking: Eight Case Studies. Transport Policy. California Air Resources Board. Retrieved from: https://www.arb.ca.gov/research/apr/past/93-308a.pdf. This citation was listed as an alternative literature in CAPCOA.	No - Applicable only in specific contexts

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Transit System	3.5.1	TST-1 Provide a Bus Rapid Transit System	0.02%-3.2% VMT reduction by converting standard bus system to BRT system	Adequate	No - the conversion of standard bus system to BRT would require local and/or regional agency coordination to implement.	No new information identified.	Same	N/A	No - Not applicable to individual land use projects
Transit System	3.5.2	TST-2 Implement Transit Access Improvements	Insufficient evidence for CEQA mitigation						No - Lack of evidence

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Transit System	3.5.3	TST-3 Expand Transit Network	0.1-8.2% VMT reduction in response to increase in transit network coverage	Adequate	No - expanding the transit network would require local and/or regional agency coordination to implement.	Reduction in vehicle trips due to increased transit service hours or coverage. Low end of reduction is typical of project-level implementation (payment of impact fees and/or localized improvements).	0.1%-10.5%	Handy, S. et al. (2013). Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm	No - Not applicable to individual land use projects
Transit System	3.5.4	TST-4 Increase Transit Service Frequency or Speed	0.02%-2.5% VMT reduction due to reduced headways and increased speed and reliability	Adequate	No - increasing the quality of transit service would require local and/or regional agency coordination to implement.	Reduction in vehicle trips due to increased transit frequency/decreased headway. Low end of reduction is typical of project-level implementation (payment of impact fees and/or localized improvements).	0.3%-6.3%	Handy, S. et al. (2013). Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm	Yes
Transit System	3.5.5	TST-5 Provide Bike Parking Near Transit	Insufficient evidence for CEQA mitigation						No - Lack of evidence
Transit System	3.5.6	TST-6 Provide Local Shuttles	Insufficient evidence for CEQA mitigation						No - Lack of evidence

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Road Pricing/ Management	3.6.1	RPT-1 Implement Area or Cordon Pricing	7.9-22.0% VMT reduction	Weak - Evidence is from other countries and does not apply to individual land use projects.	No - Only applies in central business district or urban center.	Traffic volume reductions substantiated for toll projects in the U.S. Increasing prices for VMT would likely reduce VMT.	Same	Boarnet, M. et al. (2014) Impacts of Road User Pricing on Passenger Vehicle Use and Greenhouse Gas Emissions, Policy Brief and Technical Background Report. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm Cambridge Systematics. Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions. Technical Appendices. Prepared for the Urban Land Institute. (p. B-13, B-14) http://www.movingcooler.info/Library/Documents/Moving%20Cooler_Appendix%20B_Effectiveness_102209.pdf o Referencing: VTPI, Transportation Elasticities: How Prices and Other Factors Affect Travel Behavior. July 2008. www.vtpi.org	No - Not applicable to individual land use projects
Road Pricing/ Management	3.6.2	RPT-2 Improve Traffic Flow	0-45% reduction in GHG emissions	Weak - Research does not look at individual land use projects	No - improving traffic flow would require local and/or regional agency coordination to implement.	No new information identified.			No - Not applicable to individual land use projects
Road Pricing/ Management	3.6.3	RPT-3 Require Project Contributions to Transportation Infrastructure Improvement Projects	NA - Grouped Strategy	Weak - Research does not look at individual land use projects	May be applicable if a larger VMT mitigation exchange or bank program has been established on a City- or region-wide level.	No new information identified.			No - Not applicable to individual land use projects

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Road Pricing/ Management	3.6.4	RPT-4 Install Park-and-Ride Lots	Insufficient evidence for CEQA mitigation						No - Lack of evidence
NOTES:(1) For specific VMT reduction ranges, refer to the cited literature.									