



March 30, 2015

Rachel Schuett, San Francisco Planning Department, and Carli Paine, San Francisco Municipal Transportation Agency
1650 Mission St # 400
San Francisco, CA 94103

**Subject: TDM Framework for Growth
Summary of Findings – Literature Review (Final)**

Dear Ms. Schuett and Ms. Paine:

This letter summarizes findings from a review of current transportation demand management (TDM) literature as part of the TDM Framework for Growth project. This project is an interagency effort between the San Francisco Planning Department and the San Francisco Municipal Transportation Agency (SFMTA) in partnership with the San Francisco Office of Economic and Workforce Development (OEWD) and the San Francisco County Transportation Authority (SFCTA).

This effort will support the development of a tool that models the effectiveness of various TDM strategies at reducing single-occupant vehicle (SOV) mode share, particularly during the AM and PM peak periods, and vehicle miles traveled (VMT) for trips with an origin or destination within San Francisco.

The TDM strategies included within the efficacy tool, SF+, are also included in the TDM Toolkit: a set of TDM strategies that have been developed, which are considered applicable to projects within San Francisco.

The literature review conducted for *Quantifying Greenhouse Gas Mitigation Measures*, published by the California Air Pollution Control Officers Association (CAPCOA) in 2010 (2010 CAPCOA report) is one of the most comprehensive studies conducted on the topic; and, appropriately, was used as a starting point. The subsequent research focused on articles and reports published after the 2010 CAPCOA report. Subsequent research included review of documents provided by the City, as well as other literature provided by the consultant team. A full list of literature reviewed subsequent to the 2010 CAPCOA report, is included as **Appendix A**.



EFFICACY OF TDM MEASURES

All TDM Toolkit elements were identified as being 'quantifiable' or 'non-quantifiable' in terms of effectiveness at reducing SOV trips and vehicle miles traveled (VMT). As a part of the literature review, ranges of efficacy were identified for all TDM Toolkit elements identified as quantifiable. The relevant Toolkit elements are presented in Column 1 of **Table 1** below, in their current form, but the final, complete TDM Toolkit is still in process of development. Ranges found in the 2010 CAPCOA report were revised where subsequent literature was identified that provided (1) different values more applicable to the San Francisco context, (2) more recent data, and/or (3) where the CAPCOA report provided no values.

As stated above, TDM strategies may be targeted at reducing single-occupant vehicle (SOV) mode share, AM and PM peak period SOV mode share, and vehicle miles traveled (VMT) for trips with an origin or destination within San Francisco.

For the purposes of SF+, VMT reduction was selected as the common metric by which to quantify all of the applicable (i.e. quantifiable) TDM strategies in the Toolkit. In some cases, efficacy was described in other forms in the literature, such as person-trip reduction. In such cases, methods will be applied to convert the original metrics into a measure of VMT reduction. Column 3 denotes whether a conversion was applied. Specific methods will be identified in Task 2.3C (Toolkit Model) of the scope of work.

Table 1 provides a summary of identified literature that is applicable to the TDM Toolkit strategies. Where applicable, the existing methodology and its source from the CAPCOA report are shown in Columns 2 and 4, while new quantification methods and corresponding efficacy ranges are given with their sources in Columns 5 and 6. Column 5 indicates the source of new data or methodologies and Column 6 presents the range of efficacies reported in the new data as well as key overarching observations. Column 7 presents notes relevant to each strategy, including recommended changes and methodological limitations. Some recommended changes include bundling of multiple strategies. The purpose of bundling measures is to recognize that certain measures in isolation do not have a strong impact. 'Bundling' is a policy decision to encourage developments to implement multiple measures. It will also be a policy decision to attach a small value of 'credit' to bundled measures and/or bundle (or attach) a specific unquantifiable strategy to a quantifiable one.



TABLE 1 – NEW AND EXISTING RANGES OF EFFICACY FOR TDM TOOLKIT STRATEGIES

1. TDM Toolkit Strategy	Strategies Discussed in CAPCOA Report			Additional Strategies and Updated Data		7. Notes/Caveats
	2. CAPCOA Methodology	3. Converted to VMT?	4. CAPCOA Efficacy Range ¹	5. New Methodology Source	6. New Efficacy Range ¹	
Bicycle parking	(1) Provide bike parking in non-residential projects (p 202) (2) Provide bike parking in multi-family residential projects (p 204)	N/A	(1) Strategy was evaluated in CAPCOA, but no quantification method was recommended (2) Strategy was evaluated in CAPCOA, but no quantification method was recommended	N/A	N/A	Consider bundling with other bike strategies.
Bike Room/Secure Bike Parking	(1) Provide bike parking in non-residential projects (p 202) (2) Provide bike parking in multi-family residential projects (p 204)	N/A	(1) Strategy was evaluated in CAPCOA, but no quantification method was recommended (2) Strategy was evaluated in CAPCOA, but no quantification method was recommended	N/A	N/A	Consider bundling with other bike strategies.
Bike showers/lockers	Provide End of Trip Facilities (p 234)	N/A	(1) Strategy was evaluated in CAPCOA, but no quantification method was recommended (2) Strategy was evaluated in CAPCOA, but no quantification method was recommended	N/A	N/A	Consider bundling with other bike strategies.
Bike share stations	Implement Bike-Sharing Programs (p 256)	N/A	(1) Strategy was evaluated in CAPCOA, but no quantification method was recommended	Capital Bikeshare Reports (2011 and 2013)	10% of respondents would take taxi or personal/company auto for trip surveyed about if bike share weren't available (2013 report) or 13% (2011 report)	There is a risk of less accurate results when relying on stated preference surveys without corroboration through surveys of revealed behavior changes, as is the case with the new methodology provided. We will use this new data to develop a conservative methodology for applying efficacy to this strategy. It will be important to collect data, or look for new studies, to update methodology in the future.
Bike share membership	Implement Bike-Sharing Programs (p 256)	N/A	Strategy was evaluated in CAPCOA but no quantification method was recommended	Capital Bikeshare Reports (2011 and 2013)	10% of respondents would take taxi or personal/company auto for trip surveyed about if bike share weren't available (2013 report) or 13% (2011 report)	There is a risk of less accurate results when relying on stated preference surveys without corroboration through surveys of revealed behavior changes, as is the case with the new methodology provided. We will use this new data to develop a conservative methodology for applying efficacy to this strategy. It will be important to collect data, or look for new studies, to update methodology in the future.
Bike share free rides (hotels)	Implement Bike-Sharing Programs (p 256)	N/A	Strategy was evaluated in CAPCOA but no quantification method was recommended	N/A	N/A	
Valet bicycle parking for event venues	None	N/A	None	N/A	N/A	Quantification is not provided in the tool currently, but field surveys should be a requirement of the strategy to enable future model updates. Because this strategy is aimed at special events, which all have unique features, development of an overall efficacy for this strategy at special events may ultimately prove challenging.
Bike Repair Station	None	N/A	None	N/A	N/A	Consider bundling with other bike strategies.



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Fleet of resident/employee bicycles	None	N/A	None	"CityCycle Program 2012 Report" (SF Environment 2013)	Auto-based at-work commute trips reduced by 4.8% for 0-3 mi trips and 5.9% for 3-6 mi trips, while they <i>increased</i> 1.4% for 6-12 mi trips, as a result of CityCycle (report estimates VMT reduction based on results)	The efficacy is so low that this should be considered a BMP strategy.						
Carshare parking (off-street)	Implement Car-Sharing Program (p 245)	No	<p>0.4 - 0.7% reduction in VMT for entire carshare program</p> <p>% VMT Reduction = A * B / C Where A = % reduction in car-share member annual VMT (from the literature) B = number of car share members per shared car (from the literature) C = deployment level based on urban or suburban context Detail: A: 37% (per [1]) B: 20 (per [2])</p> <table border="1"> <thead> <tr> <th>Project setting</th> <th>1 shared car per X population</th> </tr> </thead> <tbody> <tr> <td>Urban</td> <td>1,000</td> </tr> <tr> <td>Suburban</td> <td>2,000</td> </tr> </tbody> </table> <p>C: Source: <i>Moving Cooler</i></p> <p>[1] Millard-Ball, Adam. "Car-Sharing: Where and How it Succeeds," (2005) Transit Cooperative Research Program (108). P. 4-22 [2] Cambridge Systematics. <i>Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions</i>. Technical Appendices. Prepared for the Urban Land Institute. (p. B-52, Table D.3)</p>	Project setting	1 shared car per X population	Urban	1,000	Suburban	2,000	CARB Policy Brief - Impacts of Carsharing on Passenger Vehicle Use and Greenhouse Gas Emissions City CarShare Data – 2014 can be used to update deployment target based on SF-specific values in existing CAPCOA methodology ²	CARB policy brief identified a reduction in car-share member annual VMT as a range of 27% - 68%. Update existing CAPCOA methodology with new City Carshare data and CARB policy brief efficacy. In addition, discount efficacy by 50% under the assumption that some car share already exists in the City and may be captured by SF-CHAMP	
Project setting	1 shared car per X population											
Urban	1,000											
Suburban	2,000											
Carshare membership	None	No	None	CARB Policy Brief - Impacts of Carsharing on Passenger Vehicle Use and Greenhouse Gas Emissions	CARB policy brief identified a reduction in car-share member annual VMT as a range of 27% - 68%. Determine a deployment level (e.g. 1, 3, 5 years) and estimate a low/medium/high level adoption rate to apply to effectiveness shown in literature.	Carshare parking strategy should be required before getting credit for this strategy.						
Transit impact development fee (TIDF)/Transportation sustainability fee (TSF)	Required Project Contributions for Transportation Infrastructure Improvement Projects (p 297)	N/A	Strategy was evaluated in CAPCOA, but no quantification method was recommended	N/A	N/A	This is not a selectable strategy. Consider removal from list.						
Bicycle parking in-lieu fee	None	N/A	None	N/A	N/A							
Jobs-Housing Match	Increase Destination Accessibility (p 167)	No	<p>6.7% - 20% reduction in VMT</p> <p>% VMT Reduction = Center Distance * B [not to exceed 30%] Where Center Distance = Percentage decrease in distance to downtown or major job center versus typical ITE suburban development = (distance to downtown/job center for typical ITE development – distance to downtown/job center for project) / (distance to downtown/job center for typical ITE development) Center Distance = 12 - Distance to downtown/job center for project) / 12 B = Elasticity of VMT with respect to distance to downtown or major job center (0.20 from [1])</p> <p>[1] Ewing, R., and Cervero, R., "Travel and the Built Environment - A Meta-Analysis." <i>Journal of the American Planning Association</i>, <to be published> (2010). Table 4.</p>	N/A	N/A	Under discussion on whether to include or assume it is incorporated into SF-CHAMP.						



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On-Site Affordable Housing	Integrate Affordable and Below Market Rate Housing (p 176)	No	<p>0.04% - 1.20% reduction in VMT</p> <p>% VMT Reduction = 4% * Percentage of units in project that are deed-restricted BMR housing [1]</p> <p>[1] Nelson\Nygaard, 2005. Crediting Low-Traffic Developments (p.15).</p>	N/A	Apply CAPCOA methodology but discount by 50% under the assumption that some affordable housing already exists in the City and may be captured by SF-CHAMP	
Senior Housing	None	N/A	None	Update based on modified ITE and/or SF Guidelines rates	SF Typical senior trip generation rate: 5.0 trips/unit (6% at PM peak)	Inclusion of efficacy calculation will be dependent on whether special trip generation rates, such as those for senior housing, will be included in the baseline VMT calculation. If special rates are used, this efficacy calculation should be excluded to avoid double-counting.
Student Housing	None	N/A	None	N/A	N/A	
On-Site Retail/Neighborhood-Serving Retail Bonus	Increase Diversity of Urban and Suburban Developments (Mixed Use) (p 162)	No	<p>9% - 30% reduction in VMT</p> <p>% VMT Reduction = Land Use * B (not to exceed 30%)</p> <p>Where</p> <p>Land Use = Percentage increase in land use index versus single use development = (land use index - 0.15)/0.15 (see Appendix C for detail)</p> <p>Land use index = $-a / \ln(6)$ (from [2])</p> <p>a = summation (from i=1 to 6) of $a_i \times \ln(a_i)$</p> <p>a_i = building floor area of land use i / total square feet of area considered</p> <ul style="list-style-type: none"> o a_1 = single family residential o a_2 = multifamily residential o a_3 = commercial o a_4 = industrial o a_5 = institutional o a_6 = park <p>if land use is not present and a_i is equal to 0, set a_i equal to 0.01</p> <p>B = elasticity of VMT with respect to land use index (0.09 from [1]) not to exceed 500% increase</p> <p>[1] Ewing, R., and Cervero, R., "Travel and the Built Environment - A Meta-Analysis." Journal of the American Planning Association, <to be published> (2010). Table 4.</p> <p>[2] Song, Y., and Knaap, G., "Measuring the effects of mixed land uses on housing values." Regional Science and Urban Economics 34 (2004) 663-680. (p. 669)</p>	N/A	N/A	Under discussion whether to remove this strategy since it may be incorporated into SF-CHAMP
On-site day care or day-care brokerage services	None	N/A	None	N/A	N/A	
Density Bonus for Parking Reduction ²	None	N/A	None	N/A	N/A	This strategy should be considered a benefit for implementing 'Parking Supply Management' strategies, rather than a separate strategy, to avoid double-counting. Although increasing density is an important strategy for VMT reduction, density is accounted for by other means.
Parking Demand Management	(1) Unbundle Parking Costs from Property Cost (p 210) (2) Implement Employee Parking "Cash-Out" (p 266)	Yes	<p><u>(1) Unbundle Parking</u></p> <p>2.6% - 13% reduction in VMT</p> <p>% Reduction in VMT = Change in vehicle cost * elasticity * A</p> <p>211 PDT-2</p> <p>Where:</p> <p>-0.4 = elasticity of vehicle ownership with respect to total vehicle costs (lower end per VTPI)</p>	N/A	<p><u>Unbundle parking</u></p> <p>Utilize CAPCOA methodology but discount by 50% under the assumption that some unbundled parking already exists in the City and may be captured by SF-CHAMP</p> <p><u>Cash-Out</u></p> <p>Maintain CAPCOA methodology.</p>	<p><u>Cash-Out</u></p> <p>Policy discussion TBD on including this in SF+</p>



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			Change in vehicle cost = monthly parking cost * (12 / \$4,000), with \$4,000 representing the annual vehicle cost per VTPI [1] A: 85% = adjustment from vehicle ownership to VMT (see Appendix C for detail) [1] Victoria Transport Policy Institute, Parking Requirement Impacts on Housing Affordability (Annual/monthly parking fees estimated by VTPI in 2009) (p. 8, Table 3) ----- <u>(2) Parking Cash-Out</u> 0.6% - 7.7% reduction in VMT (Preferred: 3.0% - 7.7%) % VMT Reduction = A * B Where A = % reduction in commute VMT (from the literature) B = % of employees eligible Detail: A: Change in Commute VMT: 3.0% (low density suburb), 4.5% (suburban center), 7.7% (urban) change in commute VMT (from [1]) [1] Cambridge Systematics. Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions. Technical Appendices. Prepared for the Urban Land Institute. (Table 5.13, Table D.3)			
Efficient Parking (Joint, Flex, Satellite, and Space-Efficient Parking)	None	N/A	None	N/A	N/A	Consider bundling with other parking strategies.
Parking Demand Management (Construction)	None	N/A	None	N/A	N/A	
Parking Supply Management (Off-Street Parking Supply Reduction, Public and On-Street Parking)	Limit Parking Supply (p 207)	No	5% - 12.5% reduction in VMT % VMT Reduction =(Actual parking provision ITE parking generation rate) / ITE parking generation rate x 0.5	SF collected data for parking strategies	TBD	
Parking Supply Management (Off-street Parking Supply Reduction, Private) - aka Reduced Parking	Limit Parking Supply (p 207)	No	5% - 12.5% reduction in VMT % VMT Reduction =(Actual parking provision ITE parking generation rate) / ITE parking generation rate x 0.5	SF collected data for parking strategies	TBD	
Shuttle Bus Service	(1) Provide Employer-Sponsored Vanpool/Shuttle (p 253) (2) Provide Local Shuttles (p 286)	Yes	(1) 0.3% - 13.4% reduction in commute VMT % VMT Reduction = A * B * C Where A = % shift in vanpool mode share of commute trips (from [1]) B = % employees eligible C = adjustments from vanpool mode share to commute VMT Detail: A: 2-20% annual reduction in vehicle mode share (from [1]) o Low range: low degree of implementation, smaller employers o High range: high degree of implementation, larger employers C: 0.67 (see Appendix C for detail) [1] TCRP Report 95. Chapter 5: Vanpools and Buspools - Traveler Response to Transportation System Changes (p. 5-8) -- (2) Strategy was evaluated in CAPCOA but no quantification method was recommended	GHG Impacts for Commuter Shuttles Pilot Program. ICF, 2014.	Stated preference survey of ~1K intra-city shuttle users reported that 27% would have drive alone and 2.7% would have carpoled.	CAPCOA methodology is based wholly on data for vanpool programs. Care should be taken with the stated preference survey. Perhaps this could be used as a cap on effectiveness while still maintaining a similar methodology as CAPCOA.



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	2. CAPCOA Methodology	3. Converted to VMT?	4. CAPCOA Efficacy Range ¹	5. New Methodology Source	6. New Efficacy Range ¹																														
Charter buses for large events	None	N/A	None	N/A	N/A																														
Traditional school bus	Implement School Bus Program (p 258)	No	<p>38% - 63% reduction in school VMT</p> <p>% VMT Reduction = A * B Where A = % families expected to use/using school bus program B = adjustments to convert from participation to school day VMT to annual school VMT Detail: A: a typical range of 50 – 84% (from [1]) B: 75% (see Appendix C for detail)</p> <p>[1] JD Franz Research, Inc.; Lamorinda School Bus Program, 2003 Parent Survey, Final Report; January 2004 (p. 5)</p>	N/A	N/A																														
Transit subsidy	Implement Subsidized or Discounted Transit Program (p 230)	No	<p>0.3% - 20.0% reduction in commute VMT</p> <p>% VMT Reduction = A * B * C Where A = % reduction in commute vehicle trips (VT) (from [1]) B = % employees eligible C = Adjustment from commute VT to commute VMT Detail:</p> <table border="1"> <thead> <tr> <th rowspan="2">A:</th> <th colspan="4">Daily Transit Subsidy</th> </tr> <tr> <th>\$0.75</th> <th>\$1.49</th> <th>\$2.98</th> <th>\$5.96</th> </tr> </thead> <tbody> <tr> <td>Worksite Setting</td> <td colspan="4">% Reduction in Commute VT</td> </tr> <tr> <td>Low density suburb</td> <td>1.5%</td> <td>3.3%</td> <td>7.9%</td> <td>20.0%*</td> </tr> <tr> <td>Suburban center</td> <td>3.4%</td> <td>7.3%</td> <td>16.4%</td> <td>20.0%*</td> </tr> <tr> <td>Urban location</td> <td>6.2%</td> <td>12.9%</td> <td>20.0%*</td> <td>20.0%*</td> </tr> </tbody> </table> <p>* Discounts greater than 20% will be capped, as they exceed levels recommended by TCRP 95 Draft Chapter 19 and other literature.</p> <p>C: 1.0 (see Appendix C for detail)</p> <p>[1] Nelson\Nygaard, 2010. City of Santa Monica Land Use and Circulation Element EIR Report, Appendix – Santa Monica Luce Trip Reduction Impacts Analysis (p.401). [2] Nelson\Nygaard used the following literature sources: VTPI, Todd Litman, Transportation Elasticities, Comsis Corporation (1993), Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience, USDOT and Institute of Transportation Engineers</p>	A:	Daily Transit Subsidy				\$0.75	\$1.49	\$2.98	\$5.96	Worksite Setting	% Reduction in Commute VT				Low density suburb	1.5%	3.3%	7.9%	20.0%*	Suburban center	3.4%	7.3%	16.4%	20.0%*	Urban location	6.2%	12.9%	20.0%*	20.0%*	N/A	Apply CAPCOA methodology but discount by 50% under the assumption that some transit subsidy programs already exists in the City and may be captured by SF-CHAMP	
A:	Daily Transit Subsidy																																		
	\$0.75	\$1.49	\$2.98	\$5.96																															
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Real Time Transit Arrival Displays	None	N/A	None	N/A	N/A	Consider bundling with other information/marketing strategies.																													
Carpool/Vanpool Parking	None	N/A	None	N/A	N/A	Consider bundling with other carpool/vanpool strategies.																													
Vanpool program	(1) Provide Employer-Sponsored Vanpool/Shuttle (p 253) (2) Provide Local Shuttles (p 286)	Yes	<p>(1) 0.3% - 13.4% reduction in commute VMT</p> <p>% VMT Reduction = A * B * C Where A = % shift in vanpool mode share of commute trips (from [1]) B = % employees eligible C = adjustments from vanpool mode share to commute VMT Detail: A: 2-20% annual reduction in vehicle mode share (from [1]) o Low range: low degree of implementation, smaller employers o High range: high degree of implementation, larger employers C: 0.67</p> <p>[1] TCRP Report 95. Chapter 5: Vanpools and Buspools - Traveler Response to Transportation System Changes (p. 5-8) --</p>	N/A	N/A																														



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			(2) Strategy was evaluated in CAPCOA but no quantification method was recommended			
Rideshare Program	Provide Ride-Sharing Programs (p 227)	No	<p>1% - 15% reduction in commute VMT (Preferred: 5% - 15%)</p> <p>% VMT Reduction = Commute * Employee Where Commute = % reduction in commute VMT (from [1]) Employee = % employees eligible Detail: Commute: 5% (low density suburb), 10% (suburban center), 15% (urban) annual reduction in commute VMT (from [1])</p> <p>[1] VTPI. TDM Encyclopedia.</p>	N/A	N/A	This strategy should only be required as part of a TMA or in conjunction with brokerage services to ensure ongoing compliance.
Multimodal Wayfinding Signage	None	N/A	None	N/A	N/A	Consider bundling with other information/marketing strategies.
Facilitate taxi and TNC access and use	None	N/A	None	N/A	N/A	Consider bundling with other information/marketing strategies. This strategy may also include on-demand ridesharing services; consider changing name to make the strategy more comprehensive and descriptive.
Private facilities/Retail Services (Delivery service/loading spaces)	None	N/A	None	N/A	N/A	
TDM Coordinator/Site Access	Implement Commute Trip Reduction (CTR) Marketing (p 240)	Yes	<p>0.8% - 4.0% reduction in VMT (Preferred: 4% - 5% commute vehicle trip reduction from full-scale employer support)</p> <p>% Commute VMT Reduction = A * B * C Where A = % reduction in commute vehicle trips (from [1]) B = % employees eligible C = Adjustment from commute VT to commute VMT Detail: A: 4% (per [1]) C: 1.0 (see Appendix C for detail)</p> <p>[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.</p>	"Long-Term Evaluation of Individualized Marketing Programs for Travel Demand Management" (Dill and Mohr 2010)	N/A	Maintain current methodology. Range of efficacy in CAPCOA study is corroborated by Dill and Mohr's study (which includes post-program surveys administered a year after the program.)
Tailored Information, Promotions	Implement Commute Trip Reduction (CTR) Marketing (p 240)	Yes	<p>0.8% - 4.0% reduction in VMT (Preferred: 4% - 5% commute vehicle trip reduction from full-scale employer support)</p> <p>% Commute VMT Reduction = A * B * C Where A = % reduction in commute vehicle trips (from [1]) B = % employees eligible C = Adjustment from commute VT to commute VMT Detail: A: 4% (per [1]) C: 1.0 (see Appendix C for detail)</p> <p>[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.</p>	"Long-Term Evaluation of Individualized Marketing Programs for Travel Demand Management" (Dill and Mohr 2010)	N/A	Maintain current methodology. Range of efficacy in CAPCOA study is corroborated by Dill and Mohr's study (which includes post-program surveys administered a year after the program.)



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Transportation Brokerage Services	Implement Commute Trip Reduction (CTR) Marketing (p 240)	Yes	<p>0.8% - 4.0% reduction in VMT (Preferred: 4% - 5% commute vehicle trip reduction from full-scale employer support)</p> <p>% Commute VMT Reduction = A * B * C Where A = % reduction in commute vehicle trips (from [1]) B = % employees eligible C = Adjustment from commute VT to commute VMT Detail: A: 4% (per [1]) C: 1.0 (see Appendix C for detail)</p> <p>[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.</p>	"Long-Term Evaluation of Individualized Marketing Programs for Travel Demand Management" (Dill and Mohr 2010)	N/A	Maintain current methodology. Range of efficacy in CAPCOA study is corroborated by Dill and Mohr's study (which includes post-program surveys administered a year after the program.)
TDM Annual Compliance Statement	None	N/A	None	N/A	N/A	This is not a selectable strategy. Consider removal from list.

[1] Closely related strategies are likely to be non-additive and should thus not both be included in a single TDM program to avoid double-counting. Additionally, other strategies must be implemented in conjunction with one another to achieve their full efficacy.

Source: Fehr & Peers, 2015.

Ms. Schuett and Ms. Paine
March 30, 2015
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Thank you for taking the opportunity to read this letter. If you have questions, please contact Tien-Tien Chan at (415) 817-9551.

Sincerely,

FEHR & PEERS

Tien-Tien Chan, AICP
Senior Transportation Engineer/Planner

APPENDIX A – LITERATURE REVIEWED

ID#	Title	Author	Date	Notes
1	ATG Auto Trips Generated: CEQA Impact Measure & Mitigation Program	San Francisco County Transportation Authority (SFCTA)	10/27/2008	Proposal for new transportation impact measure and mitigation program by SFCTA. No quantitative or directly relevant information in report.
2	Final SAR 02-3 Strategic Analysis Report on Transportation System Level of Service (LOS) Methodologies	San Francisco County Transportation Authority (SFCTA)	12/16/2003	Review of LOS methodologies with recommendations for updates to avoid disadvantaging non-auto modes. No quantitative or directly relevant information in report.
3	LOS Background Paper – response letter to Chris Ganson, Governor’s Office of Planning and Research, from Rachel A. Schuett, San Francisco Planning Department.	Rachel A. Schuett, San Francisco Planning Department	3/5/2013	Not relevant for this task.
4	Transit Delay and Transit Crowding (draft)	Multiple Authors	Underway	Not relevant for this task.
5	Transit Analysis Corridor vs. Screenline approach (draft)	Multiple Authors	Underway	Not relevant for this task.
6	TIS Lite Memo (draft) + graphic	Multiple Authors	Underway	Not relevant for this task.
7	Draft SAR 08/09-2 Strategic Analysis Report: The Role of Shuttle Services in San Francisco’s Transportation System	San Francisco County Transportation Authority (SFCTA)	6/28/2011	Analysis of shuttle impacts on San Francisco's transportation system (high-level), a policy analysis, and potential mitigations. Data primarily concerns perceptions and usage of shuttles, car ownership etc., but not actual impact on modes. Does contain a figure on VMT potentially reduced. No appendix containing data (in-line only).
8	Bay Area Air Quality Management District (BAAQMD) Transportation Demand Management Tool, User’s Guide; Fehr & Peers, Jerry Walters, Meghan Mitman, Tien-Tien Chan	Fehr & Peers	6/4/2012	User's guide for tool for practitioners. Not directly relevant to task.
9	Transportation Demand Management Association of San Francisco (TMA SF) Connects – 2013 Annual Report; Survey Methodology, p. 28	TMA SF Connects Staff: Kimberly B. Martinson, CAE	December 2013	Detailed summary of TMA SF commute behavior survey. Data analysis is not linked to features of or changes to TDM strategies, except for self-reported influence of information about transit/commute options on behavior. The data from this report is being used for the data analysis portion of this project.
10	Quantifying Greenhouse Gas Mitigation Measures – A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures	CAPCOA	August 2010	Comprehensive review of GHG reduction strategy literature; also proposes own quantification methodologies. This report is the foundation of the TDM Toolkit
11	City and County of San Francisco Employee Transportation Survey Report (Commute Smart)	SF Environment	November 2013	Analysis of commuter survey for City employees, including an comparative longitudinal analysis that maps to the CTR program for 2010 to 2012. This also includes an analysis of the impacts of the CityCycle program (an employee bike fleet.)
12	San Francisco Countywide Transportation Plan.	San Francisco County Transportation Authority (SFCTA)	July 2005	San Francisco's 2040 Long-Range Transportation Plan. Has some numbers that may be useful for model development or policy goals in the SF context (such as the distribution of auto trip lengths, SF projected housing growth, and overloaded transit corridors.) Based on SFCHAMP model.
13	<i>Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.</i> Technical Appendices. (Table 5.13, Table D.3)	Prepared for the Urban Land Institute by Cambridge Systematics	2009	Provides extensive quantification of GHG reduction strategies based on modeling. This report was reviewed as part of CAPCOA and some strategies referenced this report in their methodologies
14	Heat Maps showing proposed increases in jobs and population (housing) by 2040 with known LOS D, E, and F intersections identified.	City Staff	Underway	Not relevant for this task.
15	Victoria Transport Institute Online TDM Encyclopedia		5/24/2014	Organized aggregation of current research/information. Reviewed for relevant information.
16	Cambridge, Massachusetts	City of Cambridge	5/24/2014	"Participation [in PTDM program] is triggered when an owner of non-residential property proposes to add parking above the registered number." This report is based on 'Large Project PTDM Plans'. Documents snapshot, but doesn't compare chronologically. Projects receive letters about compliance status and offer technical assistance. Data available in 2011 annual report (no table, just in-line)

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17	Inter-Agency Transportation Demand Management Strategy (draft)	Nelson Nygaard	2/25/2014	Draft of the inter-agency demand management strategy document. Gives basic numbers on the state of the commute (and some maps.) Also has a chart version of the N\N report findings. Does not contain any data usable to quantify impacts.
18	Memorandum to SFCTA/SFMTA Regarding TDM Partnership – TDM program Prioritization	Nelson Nygaard	1/31/2014	Nelson\Nygaard's report to the SFCTA about the TDM program prioritization/review of the literature. Provides a qualitative ranking of strategies' effectiveness, impact, cost, and impact on commute travel (0-3). Documents were taken from works cited to review for quantitative information.
19	Appraisal and Evaluation of Travel Demand Management Measures, 30th Australasian Transport Research Forum, Melbourne	Geoff Rose	2007	Provides a framework for evaluating TDM measures, particularly in a qualitative policy analysis fashion. Does not provide any specific quantitative methods or data.
20	The Case For TDM In Canada: Transportation Demand Management Initiatives And Their Benefits – A Handbook For Practitioners, Association for Commuter Transportation of Canada, Ottawa	Noxon Associates	2008	Gives guidance on collecting and analyzing TDM data, but does not contain any data. Not relevant for current task.
21	Development of Standard Performance Measures for Transportation Demand Management Programs, Transportation Research Record, 2319, 47-55	Thompson and Suter	2012	Provides a framework for evaluating TDM measures, particularly in a quasi-qualitative policy analysis fashion. Does not provide any specific quantitative methods and does not contain any data.
22	Performance Report FY 2013, Arlington County, VA	Arlington County Commuter Services	2013	Reports changes in commute patterns in Arlington and softly attributes the changes to the TDM measures (though with no statistical rigor.) Also evaluates the impact of bikeshare in the same way. None of the strategies and results are grouped or isolated. Transit service was restructured between measured base year; new bikeshare infrastructure was added compared to measured base year.
23	Complexity of Routes in Multi-Modal Wayfinding	Timpft and Heye	2002	About multimodal wayfinding, but from a psychological perspective. Not relevant for this task.
24	White Paper on Literature Review of Real-Time Transit Information Systems	Battelle	2002	Provides overview of types/features of real-time services (as of 2002), but not a focused/original study
25	Riding First Class: Impacts of Silicon Valley Shuttles on Commute & Residential Location Choice	Dai and Weinzimmer	2014	Survey of shuttle riders regarding how they would change their behavior in the absence of commuter shuttles, including mode shift information.
26	Transportation Emissions Reduction Measure Analysis Report FY 2009-2011	LDA Consulting/Metropolitan Washington Council of Governments	2012	Detailed VMT reduction evaluation (broken out by TDM strategy) for 2-year period. Based on whole DC Metro area. Also has detailed information about their calculation that could potentially be mined for relevant information <i>Doesn't include mode splits or elasticities</i>
27	Transportation Emissions Reduction Measure Analysis Report FY 2006-2008	LDA Consulting/Metropolitan Washington Council of Governments	2009	Detailed VMT reduction evaluation (broken out by TDM strategy) for 2-year period. Based on whole DC Metro area. Also has detailed information about their calculation that could potentially be mined for relevant information <i>Doesn't include mode splits or elasticities</i>
28	Transportation Emissions Reduction Measure Analysis Report FY 2003-2005	LDA Consulting/Metropolitan Washington Council of Governments	2006	Detailed VMT reduction evaluation (broken out by TDM strategy) for 2-year period. Based on whole DC Metro area. Also has detailed information about their calculation that could potentially be mined for relevant information <i>Doesn't include mode splits or elasticities</i>
29	Preliminary Evaluation of Regulation XV of the South Coast Air Quality Management District	Giuliano et al.	1991	Analysis of impact of Regulation XV of SCAQMD, which requires works sites with 100+ employees to implement ridersharing program to reach a certain AVO. 37% of sample sites were in suburban locations. This may in general have questionable applicability to SF (given that it was done in 1991 in the greater LA area)
30	TravelChoice-Alameda	TransForm	2006	Documents the results of an 8-week Door-to-Door/Phone Outreach TDM education program in Alameda, which saw a 14% decrease in SOV (due mostly to 34% increase in transit and 5% increase in carpool). Evaluation took place soon after the implementation of the program and thus does not represent mid- and long-term impacts of the program. Methodological limitations and results that are markedly higher than other related studies resulted in the decision not to use this study.
31	Guaranteed Ride Home Programs: A Study of Program Characteristics, Utilization, and Cost	Menczer	2007	Focused on cost and usage; did not contain data. Works cited were reviewed for useful documents.
32	Long-Term Evaluation of Individualized Marketing Programs for Travel Demand Management	Dill and Mohr	2010	Pre- and post-program surveys for various target areas of inner-suburban/outer urban Portland where the SmarTrips commute-trip reduction marketing program was implemented. Post-survey collection methodology demonstrated some limitations, but aggregation of data presented a consistent range centered around 4% in SOV trip reduction; number of vehicle miles traveled were not provided.

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33	CTR Report to the Washington State Legislature: 2011	Washington State CTR Board	2011	High-level discussion of policy motivation and impacts of Washington State's CTR programs. This includes things like gas prices/household budget percentages for transportation costs etc. No detailed data or calculations for the impacts are presented.
34	Smarter Travel in Outer London: Integrated Marketing in the UK	Tools of Change	2006 - 2008	Comprehensive marketing program, with 3 year post-program evaluation for one and 6-month post-program for another. Program strategies too wide/varied to make analysis/results applicable
35	Off-Model TDM Representation and Quantification Methodology for SFTP (draft)	SFCTA	Draft	Explains SF CHAMP model assumptions about TDM, including assumptions about carshare impacts on VMT and the split of mode switching to bike share
36	San Francisco City CarShare: Travel-Demand Trends and Second-Year Impacts	Cervero and Tsai	2003	Already in CAPCOA. Has very detailed info and is highly applicable to the SF context. May not take into account the changes in the car sharing landscape.
38	TCRP Report 107: Analyzing the Effectiveness of Commuter Benefits Programs	ICF Consulting and the Center for Urban Transportation Research	2005	Gives costs/benefits to practitioners for various CBP strategies. Also provides information on how to collect survey data for evaluation purposes. Contains a table with example evaluation efforts, but they are somewhat dated and much of the data/literature the table is based on is unpublished/not easily accessible
39	Infrastructure, Programs, and Policies to Increase Bicycling: An International Review	Pucher et al.	2010	A review of the literature on bicycle infrastructure, programs, and policies as of 2010. Provides a comprehensive table with each type of program and the current literature (though the specific parts of the results most useful for this exercise aren't always shown.) Has no original research or quantitative analysis, but works cited were reviewed for useful documents.
40	TCRP Report 95: Traveler Response to System Changes, Employer and Institutional TDM Strategies	Kuzmyak, Evans, and Pratt	2010	Included in CAPCOA, but was reviewed for omitted data. Contains data about efficacy of TDM strategies as ranges of Vehicle Trip Reduction. No further relevant information was found.
41	Travel in London Report 5. Chapter 10: Spotlight on the London Olympic and Paralympic Games	Transport for London	2012	Chapter 10 reviews the impacts of the Olympic Games on the transportation and discusses the success/impacts of the marketing campaign to reduce and shift trips. (5% 'background' reduction during the Olympics and 3% during Paralympics.) No detailed analysis of the impact of each strategy. Also talks about/quantifies how freight activities were changed to adapt to Games, but not as a result of TDM measures.
42	Burbank Transportation Management Organization: Impact Analysis	Brown and Aabakken	2006	Quantifies trip-reduction impacts for the BTMO trip-reduction programs from 1992-2005; this is done as an aggregate number (the different programs are not broken out.) The analysis is based on survey data collected by member employers. The analysis is not detailed enough to be used for this task and the context is relatively suburban compared to San Francisco.
43	Economics of Travel Demand Management: Comparative Cost Effectiveness and Public Investment	National Center for Transportation Research	2007	Develops methodology in a theoretical framework that captures consumers' price responsiveness to diverse transportation options by embracing most relevant trade-offs faced under income, modal price and availability constraints. It then develops a practitioner-oriented sketch planning tool. May be useful during the model-building process to incorporate pricing in a robust way, but doesn't contain any information that's useful to calibrate or validate the model.
44	Greenhouse Gas Emission Impacts of Carsharing in North America	Martin and Shaheen	2011	Calculates changes in GHG emissions as a result of carsharing based on a nationwide survey by using change in VMT of respondents before and after joining carshare. It also addresses vehicle shedding. Full impact' (adjusted for people who would have purchased a car) is -.8 t GHG/year per household reduction. The report notes that the data at the upper end of density was less reliable but that there were differences in impacts based on density. They note that not all members are 'active' members and providing zero-fixed-cost memberships may encourage VMT increase in previously inactive members and/or non-users. While the analytical methods are robust, emissions were calculated by multiplying each respondent's vehicle's emissions by their VMT; this information is not provided in a disaggregated form and it is thus difficult to accurately calculate average VMT reduction from the emissions values provided.
45	Capital Bikeshare Member Survey Report 2013	LDA Consulting	2013	Analysis of CABI system and survey of riders. Includes information about inducement of trips and changes in use of biking as a mode.
46	Capital Bikeshare Member Survey Report 2011	LDA Consulting	2012	Analysis of CABI system and survey of riders. Includes information about inducement of trips and changes in use of biking as a mode.
48	2012 Car-Free Diet Message Testing Study	Mobility Lab	2013	Analysis of survey about Arlington County Commuter Service's TDM marketing campaign, particularly as it relates to access, awareness, and perception. Sample size was very low and there was no robust evaluation of impact on commute behavior. Contains good suggestions for messaging for TDM (e.g. focus marketing on money-saving and traffic-avoidance aspects.)
49	2013 Seattle Free-Floating Car Share Pilot Program Report	Seattle Department of Transportation	2014	Preliminary report on car2go roll-out in Seattle. Includes data about cost of program and impacts on metered parking. Also has self-reported user data on whether VMT/car usage increased and whether they have or plan to shed a vehicle. The data isn't detailed or robust enough to use for modeling purposes.

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50	Moving in the 21st Century: How Ridesharing Supports Livable Communities	Volpe Center	2013	Qualitative/policy overview of benefits of ridesharing, as well as a section with information about case studies for different types of ridesharing (smartphone-enabled, dynamic, next-generation, mobility hubs, developer partnerships.) Data not robust enough to be used, but relevant works cited were examined.
51	Integrating Demand Management into the Transportation Planning Process: A Desk Reference	Battelle	2012	Gives a comprehensive matrix/description of different types of TDM strategies and programs at different geographies and levels of government, as well as suggestions for how to monitoring/analyze them (high-level suggestions, not methodological details.) Cites some studies with quantified reduction effects which may be worth reviewing. Chapter 10, p. 157 - 165 most relevant
52	Integrating Transportation Demand Management into the Planning and Development Process: A Reference for Cities	SANDAG/HNTB	2012	Gives a comprehensive matrix/description of different types of TDM strategies and programs, as well as suggestions for how to monitoring/analyze them (high-level suggestions, not methodological details.) Not relevant for this task.
53	Lessons from the Green Lanes: Evaluating Protected Bike lanes in the US	National Institute for Transportation and Communities	2014	Reports findings from video, user and resident survey, and bicycle count data evaluating US cycle tracks in terms of use, perception, benefits, and impacts. Surveys about mode shift did not ask about which mode respondents would shift to.
54	Quantifying the Business Benefits of TDM	Winters and Hendricks	2003	Review of current practices in quantifying business benefits of public transportation and TDM, as well as review tools and procedures used to measure benefits. May be useful for communicating with businesses or developers, but contains little data usable for this task.
55	Denver Bike Sharing: 2011 Annual Report	Denver Bike Sharing	2011	Annual report about Denver's bike share program, bicycle. Includes an analysis of a user survey, but doesn't have mode split or mode shift information, which makes it difficult to accurately calculate reduction in VMT.
56	Public Bikesharing in North America: Early Operator and User Understanding	Shaheen et al.	2012	Report outlines state of bikesharing in North America as of 2012 and also contains analysis of a bikeshare user survey (web-based for CABI, BIXI-Mtl, BIXI-TO, and Nice Ride), as well as a set of expert interviews. Asked how respondents used it and how often. Asked whether respondents used public transit + bike share to replace car trips and whether it has affected frequency of auto use overall, but this doesn't tell us anything about the quantity/rate of replacement or trip distance and thus makes accurate estimation of VMT reduction difficult.
57	Quantifying the Effect of Local Government Actions on VMT	Salon, Deborah (CARB)	2014	Explores heterogeneity in how much Californians will change the amount they drive in response to land use/transport characteristics using five household travel surveys. Built a model that controlled for demographic characteristics and survey characteristics. Also controlled for HH selection and residential neighborhood type.
58	CityCycle Program 2012 Report	SF Environment	May 2013	Provides evaluation of program which provides fleet of bicycles for free to City and County staff. The analysis includes an estimate of the number of VMT reduced by the program.
59	UCSF Employee Survey Results 2013	Fehr & Peers	Draft 2014	Provides analysis of results of a 2013 commute survey for UCSF employees; includes mode choice, parking location and rationale. reviewed but had no applicable data on shuttles
60	SFGH DPH/UCSF Commute Survey Draft Results	Fehr & Peers	Draft 2014	Provides combined analysis of results of a 2013 commute survey for UCSF employees; includes mode choice, parking location and rationale. reviewed but had no applicable data on shuttles
61	NCHRP Report 770: Estimating Bicycling and Walking for Planning and Project Development: A Guidebook	Kuzmyak, Walters, Bradely, and Kockelman	2014	Report provides guidance on estimating demand for bicycling and walking as influenced by various factors based on a review of current literature. They cite Hunt and Abraham (2006), which estimates that secure bike parking at a destination was valued at 8.5 to 26.5 minutes of travel time to riders in Calgary and Edmonton, but significant assumptions and calculations would need to be made in order to convert this to VMT reduction.
62	TCRP Report 166: Characteristics of Premium Transit Services that Affect Choice of Mode	Outwater et al.	2014	Report provides information on the influence of 'premium' transit characteristics (such as real-time arrival, vehicle design, service frequency etc.) based on current literature and estimates the value of these services to riders in terms of in-vehicle travel time. Real-time arrival information, estimated based on studies in three cities, was estimated to be equivalent to 0.40 – 0.62 minutes of IVTT for commute trips and 0.44 – 1.06 minutes of IVTT for non-commute trips. The report states that better data should be collected about this particular amenity, however.
63	San Francisco City CarShare: Longer-Term Travel-Demand and Car Ownership Impacts	Cervero, Golub, Nee	2006	Report provides insight on average daily VMT for members and non-members. Builds on the 2003 study. Predicts a reduction of daily VMT of 7 miles.
64	http://arb.ca.gov/cc/sb375/policies/policies.htm	Handy, Boarnet, et al.	Accessed January 2015	Reviewed all briefs and carsharing has some applicability to incorporate.
65	SF Commuter Benefits Ordinance Annual Report 2012-2013	SF Environment	2014	survey of all employers within San Francisco that participate in the ordinance. Most interesting insight was that out of the 380k eligible employees, about 25% were participating in commute programs. Not useful for methodology purposes, but good validation check.

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66	GHG Impacts for Commuter Shuttles Pilot Program	ICF	2014	Survey conducted for intra and inter city shuttle drivers - administered online; estimated GHG impacts; stated preference of ~1k intra-shuttle users reported that 27% would have driven alone and 2.7% would have carpooled.

Source: Fehr & Peers, 2015.