Quantifying Reductions in Vehicle Miles Traveled from New Pedestrian Facilities

Summary Report

California Climate Investments Quantification Methods Assessment
California Air Resources Board
Agreement #16TTD004

Prepared by:
Jamey Volker with Susan Handy, Alissa Kendall and Elisa Barbour
Institute of Transportation Studies, University of California, Davis

March 25, 2019

Background

Under California's Cap-and-Trade program, the State's portion of the proceeds from Cap-and-Trade auctions is deposited in the Greenhouse Gas Reduction Fund (GGRF). The Legislature and Governor enact budget appropriations from the GGRF for State agencies to invest in projects that help achieve the State's climate goals. These investments are collectively called California Climate Investments. Senate Bill (SB) 862 requires the California Air Resources Board (CARB) to develop guidance on reporting and quantification methods for all State agencies that receive appropriations from the GGRF. CARB may review and update quantification methodologies, as needed.

To date, multiple California Climate Investments programs have offered funding for new pedestrian facilities[1] (CARB, 2016, 2017a, 2018, 2019). CARB developed quantification methodologies to provide project-level greenhouse gas (GHG) emission reduction and co-benefit estimates for administering agencies to use when selecting projects for funding. To measure GHG emission reductions from new pedestrian facilities, CARB relies on a method it published with the California Department of Transportation (Caltrans) in 2005 for evaluating motor vehicle fee registration projects and congestion mitigation and air quality improvement (CMAQ) projects (CARB, 2016, 2018, 2019; CARB & Caltrans, 2005).

This report summarizes outcomes from a literature review to determine whether and how the CMAQ methods could be modified to better reflect emerging data and methods for estimating reductions in vehicle miles traveled (VMT) from new pedestrian facilities, the first step in estimating GHG emission reductions.[2] The report also explores how VMT reductions from new pedestrian facilities could be quantified using the alternative quantification method developed for bicycle projects in the companion technical documentation titled "Quantifying Reductions in Vehicle Miles Traveled from New Bike Paths, Lanes, and Cycle Tracks" (Bike Facility Report). This method relies on existing bicycle counts along the project corridor instead of vehicular traffic flows.

The current VMT reduction estimation equation uses five inputs: (1) days per year of facility use, (2) average annual two-way daily vehicular traffic on a road parallel to the proposed facility, (3) an adjustment factor, (4) an activity center credit, and (5) walking trip length. This report only reviews those inputs—or the components of inputs—whose values are clearly derived in the methodology documentation, specifically the facility use factor, walking trip length, and the mode share and facility-level bicycle ridership change values used to calculate the adjustment factors. The report does not probe the activity center credit values because it is unclear how they were derived. However, the reviewed literature does indicate that CARB could add another factor—a proximity minimum—based on activity center density.

[1] Pedestrian facilities are pedestrian paths, like "shared-use" Class I bike paths, sidewalks or "pedestrian passageway[s] over several lanes of heavy traffic" (CARB, 2017b [23]).

[2] The full list of literature reviewed is provided in the section F of the accompanying technical documentation.

Summary of Current Quantification Method

CARB currently uses the same equation for estimating VMT reductions from new pedestrian facilities as for estimating reductions from bicycle facilities. This equation is based (except for the trip length factor) on bicycling research, which is separately reviewed in the Bike Facility Report. CARB's current method estimates the annual VMT reductions from new pedestrian facilities using Equation 1 (CARB, 2016 [B-1], 2018 [26], 2019 [16]):

Equation 1: Auto VMT Reductions (current method)

$$Auto\ VMT\ Reduced = (D) * (ADT) * (A + C) * (L)$$

Where,

			Units
D	=	days of use per year (default is 200 days)	Days
ADT	=	annual average two-way daily vehicular traffic on parallel road (project-specific data, with a maximum of 30,000)	Trips/day
A	=	adjustment factor (table lookup value)	-
C	=	activity center credit (table lookup value)	-
L	=	walking trip length (1.0 miles/trip in one direction)	Miles/trip

The multi-component adjustment factor uses data and assumptions about mode share and facility-level change in bicycle ridership to estimate how much of the measured ADT would be converted to walking trips after pedestrian facility installation. The adjustment factors "were derived from a limited set of bicycle commute mode split data for cities and university towns in the southern and western United States,"[3] then multiplied by 0.7 to "estimate potential auto travel diverted to bikes" (same factor assumed for auto-walking substitution), and again by a 0.65 "growth factor" to "estimate the growth in bicycle trips from construction of the bike facility" (same factor used for pedestrian trip growth) (CARB & Caltrans, 2005, 31). However, it is unclear from the method documentation what portion of the cited mode split data was used to calculate the adjustment factors, or how it was used to create different factors by ADT, pedestrian facility length, city population, and "university town" status.

The activity center credit is an accessibility proxy that increases the adjustment factor for pedestrian facilities that are closer to more "activity centers," like banks, churches, hospitals, light rail stations, office parks, post offices, public libraries, shopping areas, grocery stores, or schools and universities (CARB, 2016 [B-2], 2018 [28], 2019 [17]). It is unclear how the activity center credits were derived, as there is no documentation for this component of the method.

[3] As compiled by the Federal Highway Administration in its 1992 National Bicycling and Walking Study.

Key Report Findings

The literature reviewed in the report indicates a need to update multiple factors in CARB's existing equation for estimating VMT reductions from new pedestrian facilities. The report findings include:

- The 0.65 "growth rate" for post-construction facility usage applied in the current quantification method may be low. While the evidence in the reviewed literature on pedestrian facilities is too limited to develop a walking-specific growth rate, CARB could at least update the growth rate based on the bicycling literature to keep the bicycle and pedestrian facility quantification methods consistent. Recent research documented in the companion Bike Facility Report indicates that the growth rate might be closer to 1.0 than 0.65 for Class I bike paths, Class II bike lanes, and Class IV cycle tracks that do not replace existing Class II facilities.

- The current methodology assumes a new pedestrian facility would be used a limited number of days per year. More accurate methods now exist to account for temporal variation in walking levels, though they would not be easily applied in the current methodology. Seasonal adjustment factors will become increasingly accurate and locally specific with the more widespread use of continuous automatic pedestrian counters.

- The average walking trip length could be updated from the baseline 1.0 miles used in the current quantification method, based on more recent and/or California-specific data. For example, the data from the most recent California Household Travel Survey show a shorter trip length of 0.3 miles.

- The current assumed automobile substitution rate for new pedestrian facility users (0.7) is likely too high. While there is insufficient data in the reviewed pedestrian facility literature to estimate a generalizable auto substitution rate specifically for pedestrians, the available bicycle facility data indicate an auto substitution rate of about 0.1, meaning that 10 percent of the new bicycle trips replaced driving trips. That rate (0.1) could be used as a potentially conservatively estimate for auto substitution rate for pedestrians.

- It is unclear how the activity center credits in the current methodology were derived, so the credit values themselves are not reviewed in this report. But the reviewed literature does highlight the importance of access to non-residential destinations for increasing transport walking on new pedestrian facilities. Because the literature indicates that facilities with access to non-residential destinations are most likely to increase transport walking, and because walking is the most distance-restricted travel mode, CARB could limit applicants to claiming

GHG reductions only from pedestrian facilities that have at least one activity center (as defined in the current quantification methodology) within a radius of the average walking trip length used in the quantification methodology (currently 1 mile).

Table 1 summarizes the values used in the current quantification method that could be directly updated based on the literature reviewed in the report and the companion Bike Facility Report. The next section presents the alternative quantification method.

Table 1. Summary of Potential Updates to Current Quantification Method Values

Method Input	Current Value	Updated Value
Walking Trip Growth Rate (based on bicycling trip growth rate)	0.65	1.0
Walking Trip Length	1.0 miles	0.3 miles
Auto-Walk Substitution Rate (based on auto-bike substitution rate)	0.7	0.1[4]
Activity Center Credit	Varies based on density within project area	Applicants may only claim GHG reductions from pedestrian facilities that have at least one activity center within a radius of the average walking trip length

Alternative Quantification Method

In the companion Bike Facility Report, an alternative method was developed for calculating VMT reductions from new bicycle facilities that relies solely on bicycling count data, without using vehicular ADT. The approach is also well suited for estimating VMT reductions from new pedestrian facilities.

Projecting VMT reductions from new pedestrian facilities without using vehicular ADT begins with obtaining pedestrian counts on the route for the proposed facility (or an adjacent route, if no road or path currently exists where the facility is proposed to run). The short-duration pedestrian counts must then be converted to average annual daily pedestrian trips (AADPT) using a temporal and seasonal adjustment factor. Post-installation pedestrian usage can then be estimated from that initial adjusted count using a growth factor. Multiplying that new pedestrian usage estimate by an average trip length yields new pedestrian miles traveled from adding a pedestrian facility. Not all

[4] This could be adjusted to correct for carpooling (not all pedestrians who would have made the same trip by car would have done it alone) by dividing the substitution rate (or total number of substituted trips) by the average vehicle occupancy rate (average number of people per auto) used by Caltrans (1.15) (Caltrans, 2016).

of those new walking trips replace vehicle trips, however. Further adjustment is needed, including an auto-walk substitution rate, a carpool factor (not every vehicle trip has just one occupant) and, to be conservative, a trip type factor (recreational walking trips may be less likely than utilitarian walking trips to replace auto trips).

Equation 2 is one potential pedestrian-count-based method. While there is insufficient data in the reviewed literature to develop generalizable *pedestrian*-specific values for all the inputs for the alternative quantification method, values from the bicycling literature could be used as defaults to fill those gaps, just as CARB's current quantification methodology for pedestrian facilities parrots the quantification methodology for bike facilities (with the exception of the trip length factor).

Equation 2: Auto VMT Reductions (alternative method)

$$Auto\ VMT\ Reduced = (D) * (PC) * (S) * (GF) * (AS) * (C) * (T) * (L)$$

Where,

			Units
D	=	days of use per year (default is 365 days, since counts can be adjusted seasonally)	Days/year
PC	=	average hourly (or daily) pedestrian count (either one- or two-direction, depending on whether facility will be one- or two-way; counts taken on the street to be improved with the pedestrian facility, or, in the case of a facility not on an existing street, a parallel street)	Trips/day
S	=	seasonal adjustment factor (adjusts pedestrian count to annual average daily pedestrian trips)	-
GF	=	growth factor (expected rate of increase in pedestrian count, e.g. 1.0 for a 100% increase in trips on the route)	-
AS	=	automobile substitution rate (expected rate at which pedestrians who did not walk on the same route prior to pedestrian facility installation switched from driving, or being driven in, an automobile to walking)	-
C	=	carpool factor (default is 1/1.15, to reflect the California average number of vehicle trips per person trips by personal auto)	-
T	=	trip type factor (optional inclusion for conservative estimates; default is 0.646)	-
L	=	walking trip length (default is 0.3 miles/trip in one direction)	Miles/trip

Values for the first two variables, *D* and *PC*, would be provided by the funding applicant. *D* would have a default of 365, but it could be changed based on local conditions and the type of seasonable adjustment factor used. Where possible, pedestrian counts should be taken in similar fashion across sites, for example by following the National Bicycle and Pedestrian Documentation Project methodology. The National Bicycle and Pedestrian Documentation Project recommends conducting screen line counts to identify trends in pedestrian volumes. It provides further guidance on conducting the counts in its "Instructions" manual (National Bicycle and Pedestrian Documentation

Project, 2010) and on its website.[5] The website also has standard screen line and other data collection forms for download.

The seasonal adjustment factor, *S*, could use local data where available. But to ensure continuity in application across California, the National Bicycle and Pedestrian Documentation Project's adjustment factors can be used in the interim (National Bicycle and Pedestrian Documentation Project, 2009).

The growth factor, *GF*, could be approximated based on the findings from the count-based studies discussed in the companion Bike Facility Report, given the dearth of before-and-after pedestrian counts reported in the literature for new pedestrian facilities. It appears from the bicycling literature that a uniform growth rate around 1.0 could be appropriate.

The auto substitution factor, *AS*, could likewise be based on the available data for bicycle projects discussed in the Bike Facility Report, given the dearth of pedestrian-specific modal substitution rates reported in the reviewed literature. The bicycle facility literature indicates an auto substitution rate of about 0.1. However, the auto substitution factor should be adjusted to account for carpooling (not all pedestrians who would have made the same trip by car would have done it alone).

The carpool factor, *C*, corrects for that, by dividing the total number of substituted trips by the average vehicle occupancy rate (average number of people per auto) used by Caltrans (1.15) (Caltrans, 2016).

The (optional) trip type factor, *T*, is included to correct for the fact that walking trips that are purely for exercise, sport or recreation are not as likely to substitute for auto trips as utilitarian bike trips are. The default value for *T* is based on the combined share (37.3%) of pedestrian trips made for "vacation" (1.9%) or "other social or recreational" (35.4%) purposes, taken from the 2009 NHTS. The default value is the percentage of all other (non-vacation, social or recreational) trips, calculated as 1-0.354 (=0.646). This approximation of commute and utilitarian trip share is likely conservative, however, because some of the trip purposes categorized as "other social or recreational" are arguably more similar to utilitarian trips than purely recreational trips. Furthermore, the auto substitution factor (from the bicycling literature) already corrects for recreational ridership, as it is based on the substitution rates of all surveyed cyclists combined, regardless of trip purpose (Matute, Huff, Lederman, Peza, & Johnson, 2016; Monsere et al., 2014; Thakuriah, Metaxatos, Lin, & Jensen, 2012). If the substitution factor, *AS*, were calculated based on only utilitarian trips, it would be quite a bit higher.

The trip length factor, *L*, is based on the average length of walking trips taken for any purpose, using the default 0.3-mile average from the most recent California Household Travel Survey data.

[5] Available at: http://bikepeddocumentation.org/index.php/downloads.

Ease of Applying the Alternative Quantification Method

To gauge how easy it would be to use the alternative quantification method, jurisdictions' housing projects that received funding from the Affordable Housing and Sustainable Communities program or Active Transportation Program were surveyed about the type, timing and location of their active transportation (bicycle and pedestrian) and vehicular counts, and who conducted the counts. The active transportation and vehicular count information available online for the jurisdictions was also reviewed. The results, along with the insights from the case study presented in the companion Bike Facility Report, indicate that the alternative quantification method would be at least as easy to use as the existing method, for at least two reasons.

First, once a funding applicant has the requisite hourly (or daily) pedestrian count data or vehicular ADT, the alternative quantification method can be applied more quickly than the existing method. Default values are available for all other factors in the alternative method besides the pedestrian count. The existing method, on the other hand, requires the potentially time-consuming identification and documentation of all the "activity centers" within ½-mile and ¼-mile buffers of the planned pedestrian facility.

Second, in many jurisdictions it may be just as easy for a funding applicant to obtain the requisite hourly pedestrian count data as the necessary vehicular ADT. Most of the jurisdictions for which information was obtained about their active transportation and auto traffic data collect pedestrian counts at dozens of locations, most updated at least annually. Multiple jurisdictions also collect at least some pedestrian count data using continuous counters, while multiple others are planning to either expand or initiate continuous pedestrian count programs. And many of the surveyed jurisdictions have pedestrian count data for nearly as many locations as automobile counts.

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