Updated Default Values for Transit Dependency and Average Length of Unlinked Transit Passenger Trips, for Calculations Using TAC Methods for California Climate Investments Programs

August 2019

A Summary Report from the National Center for Sustainable Transportation

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16. Abstract

The California Air Resources Board (CARB) has developed quantification methods to provide project-level greenhouse gas (GHG) and co-benefit estimates for administering agencies to use when selecting projects for funding from California Climate Investments programs. To measure GHG emission reductions from transportation projects, 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, specifically transit and connectivity (TAC) features. This report addresses whether and how CARB might update two adjustment factors in the TAC methods that apply to transit facility and/or service expansion projects. The first factor is used to account for transit dependency in estimating ridership gains from a new transit project, by indicating the share of new riders who could be expected to have driven in the absence of the project. The second factor is a required input for the estimated length of an average unlinked transit passenger trip associated with a proposed transit project. This report also summarizes recent research on factors that influence transit ridership and dependency, to inform an understanding of how these factors may influence California Climate Investments programs. Results from the literature review are described in greater detail in the accompanying technical report.

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Summary Report

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

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August 13, 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 methods, as needed.

CARB has developed quantification methods to provide project-level greenhouse gas (GHG) and co-benefit estimates for administering agencies to use when selecting projects for funding from California Climate Investments programs. To measure GHG emission reductions from transportation projects, 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, specifically transit and connectivity (TAC) features.[1]

This report addresses whether and how CARB might update two adjustment factors in the TAC methods that apply to transit facility and/or service expansion projects. The first factor is used to account for transit dependency in estimating ridership gains from a new transit project, by indicating the share of new riders who could be expected to have driven in the absence of the project. The second factor is a required input for the estimated length of an average unlinked transit passenger trip associated with a proposed transit project.

This report also summarizes recent research on factors that influence transit ridership and dependency, to inform an understanding of how these factors may influence California Climate Investments programs. Results from the literature review are described in greater detail in the accompanying technical report.

Based on a review of research on transit dependency, this report utilizes a commonly employed operational definition for transit dependent riders, in conjunction with data from the 2013 California Household Travel Survey (CHTS), to analyze non-dependent transit ridership shares by mode statewide. CARB can employ the results to update its current default values for this adjustment factor. The report also presents analysis of data from the National Transit Database (NTD) that CARB can use to update the transit trip length factor in the TAC methods.

[1] California Air Resources Board. *Methods to Find the Cost-Effectiveness of Funding Air Quality Projects for Evaluating Motor Vehicle Registration Fee Projects and Congestion Mitigation and Air Quality Improvement Projects.* May 2005. www.arb.ca.gov/planning/tsaq/eval/eval.htm.

Summary of Current Quantification Method

A number of California Climate Investments programs fund projects that expand transit facilities and/or service levels, including the Low Carbon Transit Operations Program (LCTOP), the Transit and Intercity Rail Capital Program (TIRCP), and the Affordable Housing and Sustainable Communities (AHSC) Program. For each of these programs, CARB has developed quantification methods which are described in technical documents, called "Quantification Methodology" documents, and operationalized in computational spreadsheet tools, called "Benefit Calculator Tools."[2]

CARB developed these methods for program applicants to use for estimating GHG emission reductions and selected co-benefits from projects proposed for funding. For calculations applied to transit projects, CARB's quantification methods employ the TAC methods mentioned above. Emission reductions are calculated based on an estimate of the annual reduction in vehicle miles traveled (VMT) from "displaced" auto usage attributable to the proposed project. For new or expanded service, the full estimate is calculated as the difference between the emission reductions from displaced autos and the emissions associated with the operation of the new/expanded service.

This report evaluates how CARB might update two default adjustment factors used in the TAC methods, and in CARB's quantification methods, for estimating emission reductions from transit projects. The first, an "A" factor, is used to account for transit dependency in estimating ridership gains. This factor is used to indicate the share of riders of transit projects who are not transit dependent, and therefore could be expected to have driven in the absence of the project. The second, an "L" factor, is a required input for the estimated length of an average unlinked transit passenger trip associated with the proposed project. This report does not address other aspects of the TAC methods for transit projects beyond these two factors.

These two adjustment factors appear as "A" and "L" in the following equation (Figure 1), reproduced from page 37 in CARB's Fiscal Year 2018-19 Transit and Intercity Rail Capital Program (TIRCP) Quantification Methodology document (essentially the same equation is presented in the Quantification Methodology documentation for the LCTOP and AHSC programs). Applicants seeking funds for transit projects from these programs are expected to provide input information for the "R," "A," and "L" factors shown in the equation. For the "R" factor, program applicants are expected to use information supplied by the transit agency that will build and/or operate the project (as per the case study examples offered in CARB's documentation). For the "A" and "L" factors, applicants may use default data provided in the documentation, if project-specific data or results from a cited statistically valid survey are not available to the applicant.

[2] The quantification methodology documents and associated computation spreadsheet tools are available at www.arb.ca.gov/cci-resources.

Equation 1: Annual Auto VMT Reduced in Miles per Year

$$AutoVMT = [(R) * (A) * (L)]$$

Where,			Units
R	=	Annual **increase** in unlinked passenger trips[1] directly associated with the proposed project	Riders
A	=	Adjustment factor to account for transit dependency Use: documented project-specific data or system average developed from recent, statistically valid survey or default. Default: 0.5 for local service or 0.83 for long-distance service, shuttle and vanpools.	Unitless
L	=	Estimated length of average unlinked passenger trip directly associated with the proposed project, calculated as passenger-miles[2] divided by unlinked trips. Applicants may use data reported to National Transit Database[i] for similar service or refer to Appendix C.	Mile-rider

[1] Unlinked passenger trips are defined as the number of passengers who board public transportation vehicles.
[2] The cumulative sum of the distances ridden by each passenger.

Figure 1. Estimation equation for annual auto VMT reduced from transit projects, from TAC methods. The annual auto VMT reduced is estimated as the product of the annual increase in unlinked passenger trips directly associated with the project; the adjustment factor for transit dependency; and the estimated length of average unlinked passenger trips directly associated with the proposed project.

This report suggests methods to update the default values that CARB provides for the "A" and "L" factors. As indicated, the "A" adjustment factor is used to represent the share of transit riders *not* dependent on transit (and therefore who would have driven instead). Based on the TAC methods, CARB's program documentation supplies two default values for this factor, one for "local service" (0.50) and the other for "long-distance service, shuttles, and vanpools" (0.83). The TAC methods technical documentation does not provide a cited evidence basis for the default values provided for this factor. This report provides an updated set of "A" factor default values, with a cited evidence basis.

For the "L" factor on average trip lengths associated with a proposed project, applicants are directed to use data from the NTD for similar type of service, or to refer to Appendix C in the TIRCP Quantification Methodology document, which contains look-up tables for lengths of average unlinked passenger trips by mode, both statewide and for individual transit agencies, using data from the NTD. CARB's Appendix Table C-1 shows statewide values by mode. CARB's Appendix Table C-2

shows values by mode for individual transit agencies in California using data from the 2016 NTD.

An investigation of NTD data indicates that 2016 is the most recent year for which data are available, as of the time this report was authored. This report provides updated values for CARB's Appendix Table C-1 and C-2, derived from the 2016 NTD.

Key Findings on Transit Ridership from a Review of Literature

The main objective of the literature review undertaken for this report was to determine a viable method for estimating transit dependency in order to update the "A" factor for transit non/dependency utilized in the TAC methods. The research was needed to update the default values for the "A" factor provided in the TAC methods with the latest available research. By contrast, the derivation and use for the "L" factor values, also addressed in this report, are more transparent and straightforward, and did not require any methodology review in order to update.

A commonly accepted definition for transit dependent riders, based on the literature review conducted for this report, is that they live in a household with no private vehicle available (Grengs et al., 2013, for FTA; Lachapelle et al., 2016; Clark, 2017, for APTA). Scholars have commonly defined transit dependent riders in this fashion, even though they recognize that a household's experience of accessibility is more complicated than such a simple assumption suggests (Lovejoy and Handy, 2008; Grengs et al., 2013). Access to a vehicle has been a central consideration for scholars seeking to identify and distinguish transit dependent riders, those who do not have an alternative to using transit for a given trip, from "choice" transit riders, those with a car available, but who choose to use public transit because of its comparative advantage for a given trip.

As in the case of this report, one reason that scholars and planners have sought to distinguish transit-dependent from choice transit riders is to be able to accurately assess the impact of transit improvements on patterns of driving. Another focus of concern has been equity-related, for example in considering how transit accessibility affects different socioeconomic groups, with associated benefits and burdens (Grengs et al., 2013; Karner et al., 2016). Still other scholars have focused not on the transit-dependent segment but rather upon choice riders, seeking to understand travel preferences of this group in order to try to identify strategies to attract more such riders (Krizek and El-Geneidy 2007).

Nationally, surveys conducted between 2008 and 2015 indicate that 39% of transit riders had a car available to make their current trip, while 54% had a car available at least sometimes on an ongoing basis (Clark, 2017). In the Los Angeles metro area, annual surveys conducted between 2010 and 2016 by the region's largest transit operator, LA Metro, indicate that about 30% of transit users had a vehicle available to make their trip (Manville et al., 2018). The proportion was lower among bus riders than rail riders, but even among rail riders only about 40% (depending on the survey year) reported having a vehicle available for their current trip.

Manville and co-authors (2018) compared transit users to non-users in the 6-county Los Angeles metropolitan area, using survey data from the 2013 CHTS.[3] The authors found distinctions based on race/ethnicity, immigrant status, and income. African Americans and Latinos in the Los Angeles region were three times more likely to ride transit than white non-Hispanics and Asians. Immigrants who had been in the country less than ten years rode substantially more than both the native-born and longtime immigrants who had been in the country longer. People in households earning under $25,000 per year were more than twice as likely to use transit as people in households earning $25,000 to $50,000, and in turn people from these households were more than twice as likely to use transit as people from households earning over $50,000 annually.

However, the factor that Manville and co-authors found to form the most noticeable contrast between transit users and non-users was vehicle availability. People in households with no vehicle were almost five times as likely to make transit trips as those with one vehicle, and people in households with one vehicle twice as likely as those with two vehicles (Manville et al., 2018). This finding supports the validity of using access to a vehicle as a primary indicator of transit dependency.

For this report, further review of published research was undertaken to investigate factors influencing transit ridership, with the purpose of providing useful information to CARB about trends and patterns in transit ridership that could influence CARB's methods. The findings are summarized here, and described more fully in the accompanying technical report. They indicate that scholars have sought for some time to distinguish the effects of "internal" factors, those considered to be under the control of transit agencies, such as transit service coverage, from "external" factors, not under transit agencies' control, such as population and economic growth, racial/ethnic shifts, and gas price changes. However, methods and geographic focus of studies evaluating factors that influence transit ridership have been diverse and findings have not always been consistent.

One recent study reviewed for this report (Iseki and Ali, 2015) attempted to address limitations of most previous analysis on the subject, by taking into account both temporal and cross-sectional variation across ten major US urbanized areas for the period from 2002 to 2011, and by controlling for potential endogeneity (bidirectional causality) between transit demand and supply, as well as multiple factors external to transit agencies' control but which might have influenced ridership. The study found that internal factors, especially transit system coverage, exerted greater influence than external factors upon ridership patterns across the US during the period. This finding is encouraging for California Climate Investments programs which fund increases in transit system coverage and service levels.

[3] The CHTS is conducted by Caltrans every ten years to obtain detailed information about the socioeconomic characteristics and travel behavior of households statewide. The last CHTS was conducted from January 2012 to January 2013.

However, some other recent research on transit ridership trends in the Los Angeles region tends to undermine confidence in the ability of public agencies to increase transit ridership (Manville et al., 2018). Pointing to a recent, marked trend of declining ridership in the region, the scholars attribute it to patterns of vehicle ownership, after discounting other explanations including transit system, service, and fare levels, as well as external factors including gasoline prices and rising use of services of transportation network companies (TNCs) like Lyft and Uber. The authors point to changes in the composition of foreign-born immigrants in the region, and secular shifts in the likelihood of owning vehicles, as possible explanations for the observed decline in vehicle ownership. They also provide some evidence consistent with the idea that neighborhood change has been associated with lower transit use, indicating possible replacement in transit-rich neighborhoods of transit-using residents by people more likely to drive. The authors suggest that for transit agencies to protect their fiscal health while also increasing social welfare, they may need to focus on convincing people who never use transit to begin riding occasionally instead of driving, rather than expect the transit-dependent not to shift to greater automobile use. This task aligns with goals of state agencies such as CARB to encourage transit use for non-economic reasons, such as environmental benefits, but it also points to challenges in achieving transit goals.

Across the studies reviewed for this report, a few conclusions can be drawn: first, that transit dependency remains a key variable in determining ridership, at least based on findings from the southern California study; second, that conditions of dependency are changing due to shifting patterns of vehicle access, again, at least in Southern California; third, that transit usage may also be changing due to neighborhood change; and fourth, that this combination of factors suggests that patterns of transit use among so-called "choice" (a.k.a. non-transit-dependent) riders and "potential" riders may become increasingly important as determinants of ridership in coming years, even as the needs of core transit-dependent users must also be addressed.

Updated Values for the "A" and "L" Factors

Updated values for the "A" factor—the adjustment for transit non-dependency—were obtained for this report using the 2013 CHTS. The CHTS is a survey conducted every ten years by Caltrans. It is used for forecasting in regional and state travel models, among other purposes. The most recent CHTS was conducted from January 2012 to January 2013. Data are provided by household for all trips during a given day. The survey was conducted to be representative of all households residing in the 58 counties in California; a total of 42,431 households completed the survey. The CHTS provides the most comprehensive and most recent travel survey data designed to be statistically valid statewide, and which contains information on car ownership as well as travel patterns for all trips by mode.

Table 1 provides values computed from the CHTS that CARB can utilize to update the "A" factor for transit non-dependency presented earlier in the report (in Figure 1), used to determine auto VMT reductions from California Climate Investments-funded transit projects.[4] The current default values, as seen in Figure 1, are 0.50 for "local service" and 0.83 for "long-distance service, shuttles, and vanpools." However, instead of providing only two default values based on length of trip, the CHTS-based analysis, shown in Table 1 provides values for transit non-dependency for specific travel modes, as available in the CHTS (the non-dependency value column is indicated by a bold outline in the table).

Using the data analysis presented in Table 1 as a basis for updating the required transit non-dependency "A" factor default values could provide greater granularity. First, California Climate Investments program applicants are more likely to know the modal type of transit project for which they are seeking funds than the length of trips that project users are likely to make. Second, the mode choices presented in Table 1 provide more variation in average trip lengths and non-dependency shares.

[4] The values in Table 1 are produced from the CHTS using the person-trip weight available in the "place" table.

Table 1. Transit non-dependency factors by mode, estimated from 2013 CHTS database

Mode of travel	Aver-age trip dist-ance in miles	N (# of survey observations)		Weighted percentage of unlinked trips			95% confidence interval for weighted proportion has-car	
		HH has car	HH has no car	HH has car	HH has no car	Total		
Private shuttle (SuperShuttle, employer, hotel, etc.)	12	525	74	87.9	12.1	100	85.3	90.5
Greyhound bus	85	10	2	96.5	3.5	100	n/a	n/a
Other private transit	18	287	45	82.7	17.3	100	78.6	86.8
Local bus, rapid bus	4	3,438	2,924	56.1	43.9	100	54.9	57.3
Express bus/Commuter bus (AC Transbay, Golden Gate Transit, etc.)	16	256	81	70.5	29.5	100	65.6	75.4
Premium bus (Metro Orange/Silver Line)	9	64	41	54.2	45.8	100	44.5	63.9
Public transit shuttle (DASH, Emery Go-Round, etc)	3	125	50	58.5	41.5	100	51.1	65.8
Dial-a-Ride/ParaTransit (Access Services, etc.)	8	131	90	54.0	46.0	100	47.4	60.6
Amtrak bus	93	22	2	59.9	40.1	100	n/a	n/a
Other bus	7	69	28	66.1	33.9	100	56.5	75.7
BART, Metro Red/Purple Line	13	1,405	283	79.4	20.6	100	77.5	81.4
ACE, Amtrak, Caltrain, Coaster, Metrolink	40	461	55	86.7	13.3	100	83.7	89.6
Metro Blue/Green/Gold, Muni Metro, Sacra-mento Light Rail, San Diego Sprinter/ Trolley/Orange/ Blue/Green, VTA Light Rail	7	733	272	68.5	31.5	100	65.6	71.4
Street car/Cable car	4	50	42	47.9	52.2	100	37.4	58.3
Other rail	6	88	21	73.8	26.2	100	65.5	82.2
Ferry/Boat	15	96	0	100.0	0.0	100	100.0	100.0
Total	7	7,760	4,010	62.9	37.1	100	62.0	63.8

The analysis of CHTS data presented in Table 1 indicates that some transit mode categories for which average trips are relatively short have non-dependency shares similar to the current CARB default value for "local service" (50%), including "local/rapid bus" (56.1%) and "streetcar/ cable car" (47.9%). Other modes shown in Table 1 for which average trips are longer have non-dependency shares similar to CARB's default value for "long-distance service, shuttles, and vanpools" (83%), including "private shuttle" (87.9%), "BART/Metro red/purple line" (79.4%), and "ACE/Amtrak/Caltrain/etc" (86.7%). Other modal values in Table 1 fall in between the two current default values, including those for light rail lines (68.5%) and "express bus/commute bus" (70.5%).

For the sake of sample size validity, or for other reasons, CARB might consider restricting the number of modal options from Table 1 that program applicants are asked to select among, and/or CARB might choose to aggregate modal categories (in

which case, appropriate non-dependency values would need to be calculated from the CHTS data for aggregated categories). Some mode categories shown in Table 1 contain too few survey responses (too small sample sizes) to be considered valid for providing accurate results; these modes are greyed out in the table (and confidence intervals are not calculated because the estimate is considered inappropriate for such small sample sizes). CARB might also consider aggregating categories shown in the table to produce a more limited set of options corresponding to the California Climate Investments project types eligible for funding.

To update CARB's default values for the "L" factor representing average length of trips, this report presents data findings derived from the 2016 NTD, produced by the Federal Transit Administration. Table 2 shows NTD-derived data values produced for this report that can be used to update the information on average trip lengths, currently provided in Appendix Table C-1 of CARB's TIRCP Quantification Methodology document.

Table A1 in the appendix of this report provides updates to Appendix Table C-2 of CARB's TIRCP Quantification Methodology document, which shows average length of trips by transit agency statewide. The data shown in this report are nearly identical to the data in CARB's table, as both are derived from the 2016 NTD (the latest year for which full information is available as of the time this report was authored).

Table 2. Length of average trip in California statewide by mode from 2016 National Transit Database

Mode (code)	Average trip length (miles)*	Mode description
Commuter Bus (CB)	17.99	Local fixed-route bus transportation primarily connecting outlying areas with a central city. Characterized by a motorcoach (aka over-the-road bus), multiple trip tickets, multiple stops in outlying areas, limited stops in the central city, and at least five miles of closed-door service.
Cable Car (CC)	1.25	A transit mode that is an electric railway with individually controlled transit vehicles attached to a moving cable located below the street surface and powered by engines or motors at a central location, not onboard the vehicle.
Commuter Rail (CR)	28.98	An electric or diesel propelled railway for urban passenger train service consisting of local travel which operates between a central city and outlying areas. Service must be operated on a regular basis by or under contract with a transit operator for the purpose of transporting passengers within urbanized areas (UZAs), or between urbanized areas and outlying areas. Commuter rail is generally characterized by multi-trip tickets, specific station-to-station fares, railroad employment practices, relatively long distance between stops, and only 1-2 stations in the central business district.
Demand Response (DR)	8.30	A transit mode comprised of passenger cars, vans or small buses operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations. A demand response (DR) operation is characterized by the following: a) The vehicles do not operate over a fixed route or on a fixed schedule except, perhaps, on a temporary basis to satisfy a special need, and b) Typically, the vehicle may be dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may even be interrupted en route to these destinations to pick up other passengers. The following types of operations fall under the above definitions provided they are not on a scheduled fixed route basis: many origins - many destinations; many origins - one destination; one origin - many destinations; and one origin - one destination.
Demand Response-Taxi (DT)	10.94	A special form of the demand response mode operated through taxicab providers. The mode is always purchased transportation type of service.
Ferryboat (FB)	11.81	A transit mode comprised of vessels carrying passengers over a body of water. Intercity ferryboat (FB) service is excluded, except for that portion of such service that is operated by or under contract with a public transit agency for predominantly commuter services. Predominantly commuter service means that for any given trip segment (i.e., distance between any two piers), more than 50 percent of the average daily ridership travels on the ferryboat on the same day.
Heavy Rail (HR)	11.33	A transit mode that is an electric railway with the capacity for a heavy volume of traffic. It is characterized by: a) High speed and rapid acceleration passenger rail cars operating singly or in multi-car trains on fixed rails; b) Separate rights-of-way (ROW) from which all other vehicular and foot traffic are excluded; c) Sophisticated signaling, and d) High platform loading.
Light Rail (LR)	5.16	A transit mode that typically is an electric railway with a light volume traffic capacity compared to heavy rail (HR). It is characterized by: a) Passenger rail cars operating singly (or in short, usually two car, trains) on fixed rails in shared or exclusive right-of-way (ROW); b) Low or high platform loading; and c) Vehicle power drawn from an overhead electric line via a trolley or a pantograph.
Bus (MB)	3.94	A transit mode comprised of rubber-tired passenger vehicles operating on fixed routes and schedules over roadways. Vehicles are powered by diesel, gasoline, battery, and/or alternative fuel engines contained within the vehicle.

Table 2 (continued)

Monorail/ Automated Guideway (MG)	3.20	An electrically-powered mode of transit operating in an exclusive guideway or over relatively short distances. The service is characterized by either monorail systems with human-operated vehicles straddling a single guideway or by people-mover systems with automated operation.
Bus Rapid Transit (RB)	6.44	Fixed-route bus systems that operate at least 50 percent of the service on fixed guideway. These systems also have defined passenger stations, traffic signal priority or preemption, short headway bidirectional services for a substantial part of weekdays and weekend days; low-floor vehicles or level-platform boarding, and separate branding of the service. Agencies typically use off-board fare collection as well. This is often a lower-cost alternative to light rail.
Streetcar Rail (SR)	1.48	This mode is for rail transit systems operating entire routes predominantly on streets in mixed-traffic. This service typically operates with single-car trains powered by overhead catenaries and with frequent stops.
Trolleybus (TB)	1.50	A transit mode comprised of electric rubber-tired passenger vehicles, manually steered and operating singly on city streets. Vehicles are propelled by a motor drawing current through overhead wires via trolleys, from a central power source not onboard the vehicle.
Vanpool (VP)	44.56	A transit mode comprised of vans, small buses and other vehicles operating as a ride sharing arrangement, providing transportation to a group of individuals traveling directly between their homes and a regular destination within the same geographical area. The vehicles shall have a minimum seating capacity of seven persons, including the driver. For inclusion in the NTD, it is considered mass transit service if it meets the requirements for public mass transportation and is publicly sponsored. Public mass transportation for vanpool programs must: be open to the public; be actively engaged in advertising the vanpool service to the public and in matching interested members of the public to vans with available seats; whether operated by a public or private entity, be operated in compliance with the Americans with Disabilities Act of 1990 and implementing regulations at 49 CFR 37.31; and have a record-keeping system in place to meet all NTD reporting requirements.
Hybrid Rail (YR)	8.71	Rail system primarily operating routes on the national system of railroads, but not operating with the characteristics of commuter rail. This service typically operates light rail-type vehicles as diesel multiple-unit trains (DMU's). These trains do not meet Federal Railroad Administration standards, and so must operate with temporal separation from freight rail traffic.

*Calculated by dividing passenger miles traveled by unlinked passenger trips.

References

Clark, Hugh. (2017). *Who rides public transportation*. For the American Public Transportation Association (APTA).

Grengs, Joe, Jonathan Levine, and Qingyun Shen. (2013). *Evaluating transportation equity: An inter-metropolitan comparison of regional accessibility and urban form*. FTA Report No. 0066. For the Federal Transit Administration.

Iseki, Hiroyuki, and Rubaba Ali. (2015). Fixed-effects panel data analysis of gasoline prices, fare, service supply, and service frequency on transit ridership in 10 US urbanized areas. *Transportation Research Record: Journal of the Transportation Research Board 2537*: 71-80.

Krizek, Kevin, and Ahmed El-Geneidy. (2007). Segmenting preferences and habits of transit users and non-users. *Journal of Public Transportation 10*(3): 5.

Lachapelle, Ugo, Lawrence Frank, James Sallis, Brian Saelens, and Terry Conway. (2016). Active transportation by transit-dependent and choice riders and potential displacement of leisure physical activity. *Journal of Planning Education and Research, 36*(2): 225-238.

Lovejoy, Kristin, and Susan Handy. (2008). A case for measuring individuals' access to private-vehicle travel as a matter of degrees: Lessons from focus groups with Mexican immigrants in California. *Transportation 35*(5): 601-612.

Manville, Michael, Brian Taylor, and Evelyn Blumenberg. (2018). *Falling transit ridership: California and Southern California*. For the Southern California Association of Governments.

Table A1. Length of average trip statewide by agency, from 2016 National Transit Database

Agency	Mode	Average trip length (miles)*
Access Services	DR	11.88
Access Services	DT	14.99
Alameda-Contra Costa Transit District	CB	14.38
Alameda-Contra Costa Transit District	DR	10.23
Alameda-Contra Costa Transit District	MB	3.55
Altamont Corridor Express	CR	43.00
Anaheim Transportation Network	MB	1.98
Antelope Valley Transit Authority	CB	62.54
Antelope Valley Transit Authority	DR	8.79
Antelope Valley Transit Authority	MB	14.91
Butte County Association of Governments	DR	3.82
Butte County Association of Governments	MB	5.78
California Vanpool Authority	VP	44.34
Central Contra Costa Transit Authority	DR	10.48
Central Contra Costa Transit Authority	MB	4.44
City of Commerce Municipal Buslines	DR	7.86
City of Commerce Municipal Buslines	MB	3.84
City of Elk Grove	CB	13.64
City of Elk Grove	DR	7.59
City of Elk Grove	MB	3.99
City of Fairfield - Fairfield and Suisun Transit	CB	17.86
City of Fairfield - Fairfield and Suisun Transit	DR	9.58
City of Fairfield - Fairfield and Suisun Transit	MB	2.64
City of Gardena Transportation Department	DR	3.53
City of Gardena Transportation Department	MB	3.59
City of Glendale	DR	5.16
City of Glendale	MB	2.18
City of La Mirada Transit	DR	3.00
City of Lodi - Transit Division	DR	2.65
City of Lodi - Transit Division	MB	2.81
City of Los Angeles Department of Transportation	CB	16.88
City of Los Angeles Department of Transportation	DR	4.78
City of Los Angeles Department of Transportation	DT	2.39
City of Los Angeles Department of Transportation	MB	1.36
City of Petaluma	DR	3.26
City of Petaluma	MB	2.12
City of Redondo Beach - Beach Cities Transit	DR	4.36
City of Redondo Beach - Beach Cities Transit	MB	3.90
City of Riverside Special Transportation	DR	7.49
City of San Luis Obispo	MB	2.90

City of Santa Rosa	DR	5.42
City of Santa Rosa	MB	3.83
City of Tulare	DR	6.26
City of Tulare	MB	4.23
City of Turlock	DR	7.29
City of Turlock	MB	3.28
City of Visalia - Visalia City Coach	CB	45.00
City of Visalia - Visalia City Coach	DR	7.85
City of Visalia - Visalia City Coach	MB	5.58
Claremont Dial-a-Ride	DR	4.09
Claremont Dial-a-Ride	DT	2.27
Culver City Municipal Bus Lines	DR	2.26
Culver City Municipal Bus Lines	MB	3.64
El Dorado County Transit Authority	CB	51.94
El Dorado County Transit Authority	DR	11.47
Foothill Transit	MB	8.21
Fresno Area Express	DR	7.29
Fresno Area Express	MB	2.61
Gold Coast Transit	DR	7.23
Gold Coast Transit	MB	4.10
Golden Empire Transit District	DR	7.08
Golden Empire Transit District	MB	3.61
Golden Gate Bridge, Highway and Transportation District	DR	12.42
Golden Gate Bridge, Highway and Transportation District	FB	10.95
Golden Gate Bridge, Highway and Transportation District	MB	18.12
Imperial County Transportation Commission	DR	17.27
Imperial County Transportation Commission	MB	10.35
Kings County Area Public Transit Agency	DR	3.53
Kings County Area Public Transit Agency	MB	5.53
Laguna Beach Municipal Transit	MB	2.18
Livermore / Amador Valley Transit Authority	DR	10.18
Livermore / Amador Valley Transit Authority	MB	4.96
Long Beach Transit	DR	4.58
Long Beach Transit	MB	3.22
Los Angeles County Metropolitan Transportation Authority: Metro	HR	4.88
Los Angeles County Metropolitan Transportation Authority: Metro	LR	6.88
Los Angeles County Metropolitan Transportation Authority: Metro	MB	4.11
Los Angeles County Metropolitan Transportation Authority: Metro	RB	6.44
Los Angeles County Metropolitan Transportation Authority: Metro	VP	45.42
Marin County Transit District	DR	8.24
Marin County Transit District	MB	4.06
Modesto Area Express	DR	7.14
Modesto Area Express	DT	4.93
Modesto Area Express	MB	3.38

Montebello Bus Lines	DT	2.09
Montebello Bus Lines	MB	3.24
Monterey-Salinas Transit	CB	40.42
Monterey-Salinas Transit	DR	12.65
Monterey-Salinas Transit	MB	5.76
Napa Valley Transportation Authority	CB	21.58
Napa Valley Transportation Authority	DR	7.32
Napa Valley Transportation Authority	MB	7.45
North County Transit District	CR	28.11
North County Transit District	DR	13.22
North County Transit District	MB	5.03
North County Transit District	YR	8.71
Norwalk Transit System	DR	3.58
Norwalk Transit System	MB	3.35
Omnitrans	DR	14.24
Omnitrans	MB	5.19
Orange County Transportation Authority	CB	20.66
Orange County Transportation Authority	DR	11.29
Orange County Transportation Authority	DT	3.02
Orange County Transportation Authority	MB	3.53
Orange County Transportation Authority	VP	34.57
Paratransit, Inc.	DR	9.51
Paratransit, Inc.	DT	7.91
Peninsula Corridor Joint Powers Board dba: Caltrain	CR	26.60
Peninsula Corridor Joint Powers Board dba: Caltrain	MB	3.47
Placer County Department of Public Works and Facilities	CB	21.99
Placer County Department of Public Works and Facilities	DR	3.82
Placer County Department of Public Works and Facilities	DT	13.86
Placer County Department of Public Works and Facilities	MB	7.81
Placer County Department of Public Works and Facilities	VP	39.74
Pomona Valley Transportation Authority	DR	5.02
Pomona Valley Transportation Authority	DT	4.89
Redding Area Bus Authority	DR	9.06
Redding Area Bus Authority	MB	6.50
Riverside Transit Agency	CB	20.56
Riverside Transit Agency	DR	12.54
Riverside Transit Agency	DT	16.56
Riverside Transit Agency	MB	6.33
Sacramento Regional Transit District	DR	2.66
Sacramento Regional Transit District	LR	5.66
Sacramento Regional Transit District	MB	3.63
San Diego Association of Governments	VP	48.79
San Diego Metropolitan Transit System	CB	23.69
San Diego Metropolitan Transit System	DR	9.98
San Diego Metropolitan Transit System	LR	5.56
San Diego Metropolitan Transit System	MB	3.84
San Francisco Bay Area Rapid Transit District	HR	13.50
San Francisco Bay Area Rapid Transit District	MG	3.20
San Francisco Bay Area Water Emergency Transportation Authority	FB	14.85

San Francisco Municipal Railway	CC	1.25
San Francisco Municipal Railway	DR	6.03
San Francisco Municipal Railway	LR	2.72
San Francisco Municipal Railway	MB	2.26
San Francisco Municipal Railway	SR	1.48
San Francisco Municipal Railway	TB	1.50
San Joaquin Regional Transit District	CB	44.30
San Joaquin Regional Transit District	DR	11.30
San Joaquin Regional Transit District	DT	6.48
San Joaquin Regional Transit District	MB	3.64
San Luis Obispo Regional Transit Authority	DR	7.95
San Luis Obispo Regional Transit Authority	MB	12.43
San Mateo County Transit District	DR	8.45
San Mateo County Transit District	DT	13.11
San Mateo County Transit District	MB	4.69
Santa Barbara Metropolitan Transit District	MB	4.59
Santa Clara Valley Transportation Authority	DR	10.12
Santa Clara Valley Transportation Authority	LR	5.10
Santa Clara Valley Transportation Authority	MB	5.88
Santa Clarita Transit	CB	19.28
Santa Clarita Transit	DR	8.07
Santa Clarita Transit	MB	4.38
Santa Cruz Metropolitan Transit District	CB	31.21
Santa Cruz Metropolitan Transit District	DR	6.70
Santa Cruz Metropolitan Transit District	DT	6.70
Santa Cruz Metropolitan Transit District	MB	5.34
Santa Maria Area Transit	DR	5.48
Santa Maria Area Transit	MB	4.37
Santa Monica's Big Blue Bus	DR	2.49
Santa Monica's Big Blue Bus	MB	4.23
Solano County Transit	CB	12.72
Solano County Transit	DR	6.10
Solano County Transit	MB	3.06
Sonoma County Transit	DR	12.52
Sonoma County Transit	MB	8.37
Southern California Regional Rail Authority: Metrolink	CR	30.93
SunLine Transit Agency	DR	11.94
SunLine Transit Agency	MB	7.14
The Eastern Contra Costa Transit Authority	DR	6.26
The Eastern Contra Costa Transit Authority	MB	7.26
Torrance Transit System	DT	6.17
Torrance Transit System	MB	4.40
Transit Joint Powers Authority for Merced County	DR	6.05
Transit Joint Powers Authority for Merced County	MB	6.31
Unitrans - City of Davis/ASUCD	MB	2.15
Ventura Intercity Service Transit Authority	CB	11.60
Ventura Intercity Service Transit Authority	DR	4.27
Ventura Intercity Service Transit Authority	MB	4.40

Victor Valley Transit Authority	CB	51.18
Victor Valley Transit Authority	DR	13.83
Victor Valley Transit Authority	MB	6.23
Victor Valley Transit Authority	VP	47.11
Western Contra Costa Transit Authority	CB	23.19
Western Contra Costa Transit Authority	DR	7.47
Western Contra Costa Transit Authority	MB	7.43
Yolo County Transportation District	DR	11.05
Yolo County Transportation District	MB	10.39
Yuba-Sutter Transit Authority	CB	38.82
Yuba-Sutter Transit Authority	DR	6.90
Yuba-Sutter Transit Authority	MB	2.99

*Calculated by dividing passenger miles traveled by unlinked passenger trips.