California Air Resources Board

Co-benefit Assessment Methodology
Travel Cost Savings

California Climate Investments
Greenhouse Gas Reduction Fund

FINAL
December 23, 2022

Table of Contents

List of Acronyms and Abbreviations

Acronym	Term
AB	Assembly Bill
CARB	California Air Resources Board
CB	commuter bus
CC	cable car
CR	commuter rail
DO	directly operated
DR	demand response
DT	demand response taxi
FB	ferryboat
GGRF	Greenhouse Gas Reduction Fund
GHG	greenhouse gas
HR	heavy rail
LR	light rail
MB	bus
MG	monorail/automated guideway
PT	purchased transportation
RB	bus rapid transit
SR	streetcar rail
TB	trolley bus
TN	transit network company
TX	taxi
VMT	vehicle miles traveled
VP	vanpool
YR	hybrid rail

Section A. Introduction

The goal of California Climate Investments is to reduce GHG emissions and further the objectives of the California Global Warming Solutions Act of 2006, AB 32. CARB is responsible for providing guidance on reporting and quantification methods for all State agencies that receive appropriations from the GGRF. Guidance includes developing methodologies for estimating GHG emission reductions and other economic, environmental, and public health benefits of projects, referred to as "co-benefits."

The Center for Resource Efficient Communities at the University of California, Berkeley (UC Berkeley), in consultation with CARB staff, developed this Co-benefit Assessment Methodology to estimate travel cost savings for relevant California Climate Investments programs.

Co-benefit Assessment Methodologies are intended for use by administering agencies, project applicants, and/or funding recipients to estimate the outcomes of California Climate Investments. Co-benefit estimates can be used to inform project selection and track results of funded projects. In addition to this methodology, general guidance on assessing California Climate Investment co-benefits is available in CARB's Funding Guidelines for Agencies Administering California Climate Investments (Funding Guidelines) available at: www.arb.ca.gov/cci-fundingguidelines.

Travel Cost Savings Co-benefit Description

Travel cost savings refers to a change in the overall cost of travel for users of the transportation system who receive a subsidy for travel (e.g., transit voucher) or switch travel modes (e.g., switch from driving a car to riding mass transit, biking, or walking) as a result of a California Climate Investments project. Mode shift may occur because a California Climate Investments project creates new transit, biking, or walking infrastructure, or new housing or land use strategies that enable residents to make better use of existing transit, biking, and walking opportunities. This methodology uses the most up-to-date travel price data available at the time of publication; CARB may modify default price values as the original source material is updated.

California Climate Investments can cause positive or negative travel cost savings co-benefits. These co-benefits may accrue directly (as a central objective of the project) or indirectly (as a consequence of project activities).

A ***positive*** travel cost savings co-benefit results when a California Climate Investments project decreases travel costs through distribution of travel subsidies or by encouraging users to switch their travel from a more expensive to a less expensive mode.

A ***negative*** travel cost savings co-benefit results when a California Climate Investments project increases travel costs by encouraging users to switch their travel from a less expensive to a more expensive mode. This may include some situations where travel costs increase because the ability to travel also increases (e.g., a project provides car sharing or vanpool access to people who previously had no transit or vehicle access, adding mobility options but also costs).

Travel Cost Savings Co-benefit Projects

This Co-benefit Assessment Methodology may apply to California Climate Investments[1] projects that involve:

- Transit service expansion, infrastructure, or vouchers;
- Car sharing, vanpooling, ride-sharing, and other mobility options;
- Affordable housing; and
- Active transportation infrastructure or vouchers.

California Climate Investments that result in travel cost savings co-benefits fall into two project categories covered by this Co-benefit Assessment Methodology.

> **Project Category 1. Mode Shift:** Projects that result in users switching their mode of travel by enabling people to ride a transit or utilize new mobility options instead of driving or flying by creating, expanding, connecting, or modernizing public transit and new mobility services. Location efficiency and active transportation projects can result in mode-shift by stimulating the use of mass transit or active transportation by improving accessibility and building sidewalks, bike paths, protected lanes or urban trails.
>
> **Project Category 2. Travel Subsidy:** Projects that provide a reduced fare, voucher, or other price reduction for public transit, car sharing, or other form of less carbon intensive travel.

A single California Climate Investments project may fall into more than one of the above categories. In such cases, users should estimate the cost savings from each and add them together.[2]

This methodology focuses on cost savings from mode shift and travel subsidies only. Cost savings for drivers of more fuel-efficient vehicles and cost savings for transit agencies and operators are estimated using the Energy and Fuel Cost Savings Co-benefit Assessment Methodology[3] and are not included here to avoid double-counting of co-benefits.

[1] This list is based off of project types funded by the Greenhouse Gas Reduction Fund as of April 2018 and may be modified as California Climate Investments evolve or expand.
[2] To avoid double counting, each project component should be calculated in only one project category.
[3] California Air Resources Board. Energy and Fuel Cost Savings Co-benefit Assessment Methodology. www.arb.ca.gov/cci-cobenefits.

Methodology Development

UC Berkeley developed this Co-benefit Assessment Methodology, consistent with the guiding principles of California Climate Investments. The methodology is developed to:

- Support calculating the applicable co-benefits for individual projects;
- Apply to the project types proposed for funding;
- Provide uniform methods that can be applied statewide and are accessible by all applicants and funding recipients;
- Use existing and proven tools or methods, where available;
- Include the expected period of time for when co-benefits will be achieved; and
- Identify the appropriate data needed to calculate co-benefits.

UC Berkeley assessed peer-reviewed literature and consulted with experts, as needed, to identify:

- The direction and magnitude of the co-benefit;
- Project types to which the co-benefit is relevant;
- The limitations of existing empirical literature;
- Existing assessment methods and tools; and
- Knowledge gaps and other issues to consider in developing co-benefit assessment methods.

This work is summarized in a literature review on this co-benefit, which can be found at: www.arb.ca.gov/cci-cobenefits. UC Berkeley also considered ease of use, specifically the availability of project-level inputs from users for the applicable California Climate Investments programs.

CARB released the Draft Travel Cost Savings Co-benefit Assessment Methodology for public comment in December 8, 2022. This Final Travel Cost Savings Co-benefit Assessment Methodology has been updated to address public comments, where appropriate.

Administering agencies, project applicants, and/or funding recipients estimate GHG emission reductions using CARB GHG Quantification Methodologies and Calculator Tools. Some of the data used for estimating GHG emission reductions may also be used to estimate travel cost savings co-benefits. CARB anticipates incorporating methods used to estimate the travel cost savings co-benefit into CARB Calculator Tools.

Updates

CARB staff periodically review each co-benefit assessment methodology to evaluate their effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified. CARB updated the Travel Cost Savings Co-benefit Assessment Methodology from the previous version to enhance the analysis and provide additional clarity. The changes include:

- Updating the average cost of flying in Table 1 and Table 2 using the latest data from the U.S. Department of Transportation (2021 annual average); and
- Updating the average trip length and average fare cost per trip information in Table 3 and Table 4 using the latest data from the National Transit Database[4] (2021 annual average).

Program Assistance

For assistance with this Co-benefit Assessment Methodology, send questions to: GGRFProgram@arb.ca.gov. For more information on CARB's efforts to support implementation of California Climate Investments, see: ww2.arb.ca.gov/auctionproceeds.

[4] Federal Transit Administration. National Transit Database. Available at https://www.transit.dot.gov/ntd.

Section B. Co-benefit Assessment Methods

This section describes how users estimate travel cost savings by project category. Overall, the methods for assessing the travel cost savings are quantitative, amounting to estimating the subsidy value or level of mode shift and the associated costs to travelers during the project quantification period[5] compared to a no-project scenario.

Additional information about the specific data inputs (e.g., default values and data sources) is provided in Section C and Appendices A and B. Examples of how to apply the methods and data inputs needed for a transit project and an active transportation project are provided in Appendices C and D, respectively.

Project Category 1. Mode Shift

Project Category 1 includes projects that result in users switching their mode of travel.

Travel Cost Savings from mode shift is estimated using the equations below. Not all equations or inputs will apply to every project; users only need to determine inputs that are relevant to the project. If a project results in travelers switching from vehicle travel to both transit and active transportation, users need to estimate the approximate proportion of avoided VMT that is attributable to each measure.

Equation 1 estimates the travel cost savings co-benefits for California Climate Investments in Project Category 1.

Equation 1: Travel Cost Savings from Mode Shift

$$Travel\ Cost\ Savings_{Mode\ Shift} = (Travel\ Cost\ of\ Baseline\ Mode - Travel\ Cost\ of\ New\ Mode) \times Adjustment\ Factor \times Quantification\ Period$$

Where,			Units
Travel Cost Savings$_{Mode\ Shift}$	=	Travel cost savings or cost increase during the project quantification period as a result of the project. Cost savings should be reported as a positive (+) dollar value and cost increase should be reported as a negative (-) dollar value.	$
Travel Cost of Baseline Mode	=	Annual estimated cost of the baseline mode of travel prior to the project.	$/year
Travel Cost of New Mode	=	Annual estimated cost of the new mode of travel as a result of the project.	$/year
Adjustment Factor	=	Percentage of total ridership that are choice riders (transit non-dependent).	unitless
Quantification Period	=	Number of years that the project subcomponent will provide GHG emission reductions that can reasonable be achieved and assured. Sometimes also referred to as "Project Life" or "Useful Life".	years

[5] The project quantification period varies for the different programs and is defined in each of CARB's GHG Quantification Methodologies and Calculator Tools.

The **Travel Cost of Baseline Mode** is the cost associated with the mode of travel a user switches from. California Climate Investments projects typically have a baseline travel mode of personal auto vehicles or airplanes. Travel Cost of Baseline Mode is calculated as the sum of baseline transportation, parking, and toll costs.

Equation 2: Travel Cost of Baseline Mode

$$Travel\ Cost\ of\ Baseline\ Mode = Transportation\ Cost_{Baseline} + Parking\ Cost_{Baseline} + Toll\ Cost_{Baseline}$$

Where,			Units
Travel Cost of Baseline Mode	=	Annual estimated cost of the baseline mode of travel prior to the project.	$/year
$Transportation\ Cost_{Baseline}$	=	Annual cost of airfare or the cost to operate the vehicle for the length of the trip(s)	$/year
$Parking\ Cost_{Baseline}$	=	Annual cost of parking associated with baseline trip(s)	$/year
$Toll\ Cost_{Baseline}$	=	Annual cost of tolls associated with baseline trip(s)	$/year

Transportation Costs, Parking Costs, and Toll Costs are calculated using Equation 3 through Equation 5, respectively. The transportation cost of baseline mode is calculated as the cost per mile for the current mode of transportation multiplied by the respective annual mileage.

Equation 3: Transportation Cost of Baseline Mode

$$Transportation\ Cost_{Baseline} = Cost\ Per\ Mile_{Baseline} \times Miles_{Baseline}$$

Where,			Units
$Transportation\ Cost_{Baseline}$	=	Annual cost of airfare or the cost to operate the vehicle for the length of the trip(s)	$/year
$Cost\ per\ Mile_{Baseline}$	=	Cost per mile of airfare or to operate the vehicle	$/mile
$Miles_{Baseline}$	=	Total annual air or vehicle mileage for the trip(s)	miles/year

The parking cost of baseline mode is calculated by summing the avoided parking costs associated with the number of weekday and weekend trips and the parking rates for each.

Equation 4: Parking Cost of Baseline Mode

$$Parking\ Cost_{Baseline} = Avoided\ Parking_{Wd} \times Parking\ Cost_{Baseline\ ,Wd} + Avoided\ Parking_{Baseline\ ,We} \times Parking\ Cost_{We}$$

Where,			Units
$Parking\ Cost_{Baseline}$	=	Annual cost of parking associated with baseline trip(s)	$/year
$Avoided\ Parking_{Wd}$	=	Annual expected avoided parking on weekdays associated with the increase in transit ridership, bike trips, or pedestrian trips	roundtrips/yr
$Parking\ Cost_{Baseline,Wd}$	=	Weekday cost for parking associated with baseline trip(s)	$/trip
$Avoided\ Parking_{We}$	=	Annual expected avoided parking on weekends associated with the increase in transit ridership, bike trips, or pedestrian trips	roundtrips/yr
$Parking\ Cost_{Baseline,Wd}$	=	Weekend cost for parking associated with baseline trip(s)	$/trip

The toll cost of baseline mode is calculated as the annual number of tolls avoided multiplied by the cost of tolls.

Equation 5: Toll Cost of Baseline Mode

$$Toll\ Cost_{Base} = Avoided\ Tolls \times Toll\ Rate$$

Where,			Units
$Toll\ Cost_{Baseline}$	=	Annual cost of tolls associated with baseline trip(s)	$/year
Avoided Tolls	=	Annual expected number of avoided tolls associated with the increase in transit ridership, bike trips, or pedestrian trips	roundtrips/yr
Toll Rate	=	Cost of tolls avoided	$/roundtrip

The **Travel Cost of the New Mode** is the cost associated with the mode of travel a user switches to. California Climate Investments projects typically have a new travel mode of public transit, car share or other mobility option, bicycling, or walking. Travel Cost of New Mode is calculated using the following approach:

Equation 6: Travel Cost of New Mode

$$Travel\ Cost\ of\ New\ Mode = Transit\ Cost_{New} + Mobility\ Cost_{New} + Parking\ Cost_{New} + Active\ Transportation\ Cost_{New}$$

Where,			Units
Travel Cost of New Mode	=	Annual estimated cost of the new mode of travel as a result of the project.	$/year
Transit $Cost_{New}$	=	Annual cost of transit fares associated with the increase in ridership	$/year
Mobility $Cost_{New}$	=	Annual cost of car share, vanpool, rideshare and other mobility options associated with the increase in use	$/year
Parking $Cost_{New}$	=	Annual cost of parking associated with new trip(s), e.g., parking at a transit facility	$/year
Active Transportation $Cost_{New}$	=	Annual cost to operate the mode of active transportation (e.g., bicycle, scooter) for the length of the trip(s)	$/year

Transit Cost, Mobility Cost, Parking Cost, and Active Transportation Cost[6] can be calculated using Equation 7 through Equation 10, respectively. The transit cost of new mode is calculated as the increased number of transit users multiplied by the average transit fare cost.

Equation 7: Transit Cost of New Mode

$$Transit\ Cost_{New} = User\ Increase \times Average\ Fare$$

Where,			Units
Transit $Cost_{New}$	=	Annual cost of transit fares associated with the increase in ridership	$/year
User Increase	=	Annual expected increase in transit ridership	trips/year
Average Fare	=	Average transit system one-way fare	$/trip

[6] Active transportation costs are the costs associated with bicycles, scooters, or other forms of pedestrian conveyance. Walking trips are assumed to be free of cost.

The mobility cost of new mode is calculated as the increased number of mobility users multiplied by the average fare cost of the respective mobility service, summed for all mobility services used by the project.

Equation 8: Mobility Cost of New Mode

$$Mobility\ Cost_{New} = \sum User\ Increase_{Service} \times Average\ Fare_{Service}$$

Where,			Units
Mobility $Cost_{New}$	=	Annual cost of car share, vanpool, rideshare and other mobility options associated with the increase in use	$/year
User $Increase_{Service}$	=	Expected increase in use, by mobility service type	trips/year
Average $Fare_{Service}$	=	Average mobility service one-way fare, by mobility service type	$/trip

The parking cost of new mode is calculated by summing the parking costs associated with the number of weekday and weekend trips and the parking rates for each.

Equation 9: Parking Cost of New Mode

$$Parking\ Cost_{New} = Parking_{Wd} \times Parking\ Cost_{New,Wd} + Parking_{We} \times Parking\ Cost_{New,We}$$

Where,			Units
Parking $Cost_{New}$	=	Annual cost of parking associated with new mode trip(s)	$/year
$Parking_{Wd}$	=	Annual expected parking on weekdays associated with the increase in transit ridership	roundtrips/yr
Parking $Cost_{New,Wd}$	=	Weekday cost for parking associated with new mode trip(s)	$/trip
$Parking_{We}$	=	Annual expected parking on weekends associated with the increase in transit ridership	roundtrips/yr
Cost $_{New,Wd}$	=	Weekend cost for parking associated with new mode trip(s)	$/trip

The active transportation cost of new mode is calculated as the cost per mile for the new mode of active transportation multiplied by the respective annual mileage.

Equation 10: Active Transportation Cost of New Mode

$$Active\ Transportation\ Cost_{New} = Cost\ Per\ Mile_{Active} \times Miles_{Active}$$

Where,			Units
Active Transportation $Cost_{New}$	=	Annual cost to operate the mode of active transportation (e.g., bicycle, scooter) for the length of the trip(s)	$/year
Cost Per $Mile_{Active}$	=	Cost per mile to operate the mode of active transportation	$/mile
$Miles_{Active}$	=	Total annual mileage for the active transportation trip(s)	miles/year

Project Category 2. Travel Costs Savings of Travel Subsidy

Project Category 2 includes projects that provide a reduced fare, voucher, or other price reduction for public transit, car sharing, or other form of less carbon intensive travel. Travel Cost Savings from travel subsidies is calculated using the following approach:

Equation 11: Travel Cost Savings from Travel Subsidy

$$Travel\ Cost\ Savings_{Travel\ Subsidy} = Travel\ Cost\ Savings_{Mode\ Shift} + (Travel\ Cost\ Savings_{Fare\ Reduction} + Travel\ Cost\ Savings_{Voucher}) \times (1 - Adjustment\ Factor_{Travel\ Subsidy}) \times Quantification\ Period$$

Where,			Units
$Travel\ Cost\ Savings_{Travel\ Subsidy}$	=	Travel cost savings during the project quantification period as a result of the project. Cost savings should be reported as a positive (+) dollar value and cost increase should be reported as a negative (-) dollar value.	$
$Travel\ Cost\ Savings_{Mode\ Shift}$	=	Travel cost savings or cost increase during the project quantification period as a result of the project. Cost savings should be reported as a positive (+) dollar value and cost increase should be reported as a negative (-) dollar value.	$
$Travel\ Cost\ Savings_{Fare\ Reduction}$	=	Travel cost savings associated with fare reductions	$/year
$Travel\ Cost\ Savings_{Voucher}$	=	Travel cost savings associated with travel vouchers provided by the project	$/year
$Adjustment\ Factor_{Travel\ Subsidy}$	=	Percentage of total ridership that are choice riders (transit non-dependent) for the travel subsidy.	unitless
Quantification Period	=	Number of years that the project subcomponent will provide GHG emission reductions that can reasonable be achieved and assured. Sometimes also referred to as "Project Life" or "Useful Life".	years

Travel cost savings from mode shift are calculated using Equation 1, associated with an increase in non-dependent riders. Travel cost savings from fare reductions and vouchers can be calculated using Equation 12 and Equation 13, respectively, associated with savings observed by choice (dependent) riders.

For certain projects or programs, the transit non-dependency adjustment factor for travel subsidies may be assumed to be zero to credit all of the subsidy funding provided by the project or program. This applies to voucher projects when only the voucher value is known and the fare costs are unknown.

If a project involves travel subsidies for more than one type of service (e.g., transit and car sharing), the cost savings for each service must be calculated separately.

Equation 12: Travel Cost Savings from Fare Reductions

$$Travel\ Cost\ Savings_{Fare\ Reduction} = Users \times (Baseline\ Fare\ Cost - New\ Fare\ Cost)$$

Where,			Units
Travel Cost Savings$_{Fare\ Reduction}$	=	Travel cost savings associated with fare reductions	$/year
Users	=	Annual quantity of riders or users of a particular service subject to fare reduction	trips/year
Baseline Fare Cost	=	Average fare cost for a particular service prior to project implementation	$/trip
New Fare Cost	=	Average reduced fare cost for a particular service due to project implementation	$/trip

Equation 13: Travel Cost Savings from Vouchers

$$Travel\ Cost\ Savings_{Voucher} = Voucher\ Quantity \times Voucher\ Value$$

or

$$Travel\ Cost\ Savings_{Voucher} = Voucher\ Quantity \times Voucher\ Trip\ Value \times (Baseline\ Fare\ Cost - New\ Fare\ Cost)$$

Where,			Units
Travel Cost Savings$_{Voucher}$	=	Travel cost savings associated with travel vouchers provided by the project	$/year
Voucher Quantity	=	Annual number of vouchers provided by the project	vouchers/year
Voucher Value	=	Monetary value associated with each individual voucher provided by the project	$/voucher
Voucher Trip Value	=	The number of trips funded per each voucher (typically only one trip per voucher)	trips/voucher
Baseline Fare Cost	=	Average fare cost for a particular service prior to project implementation	$/trip
New Fare Cost	=	Average reduced fare cost for a particular service due to the voucher subsidy	$/trip

Section C. Data Requirements and Tools

This section describes the data requirements and tools required for the Travel Cost Savings Co-benefit Assessment Methodology. The data that a user will need to provide will vary by project category and may include the following:

- **Cost Per Mile:** The cost per mile rate for driving and biking is the cost per California Department of Human Resources Mileage Reimbursement Rates. For 2022, the average State of California mileage reimbursement rate for personal vehicles and bicycles is 60.5 cents per mile and 4 cents per mile, respectively.[7] The cost per mile rate for flying is estimated using the default values from Table 1 in Appendix A.[8] For projects that enhance walking conditions, the per-mile cost of walking is assumed to be zero.
- **Miles:** The miles traveled for the baseline mode is the number of miles that would have been traveled by driving a personal vehicle (avoided VMT), or by flying, that will instead be traveled by transit or active transportation. For on-road transit, refer to Appendix B for information on the length of an average trip categorized by transit agency, transit mode, and type of service). The miles traveled by bicycle for projects that include active transportation is the distance traveled by bicycle resulting from the project, if known. If the distance traveled by bicycle due to the project is unknown, avoided VMT should be used.
- **Avoided Parking:** Avoided parking costs may be relevant for some projects, particularly those likely to reduce driving in urban downtowns or commercial districts. Avoided parking is the projected change in ridership to the downtown on weekdays and weekends. Ridership is counted in one-way trips, so for use in estimating avoided parking, ridership should be cut in half since only one parking event is included for two one-way trips (one round trip).
- **Parking Cost:** The baseline scenario cost of parking is the statewide average of $11.13 per weekday trip and $1.50 per hour for weekend trips. The project scenario cost of parking is $3 per weekday trip if there is paid parking at the transit facilities where the trip originates and $0 for weekend trips.[9] For parking costs associated with weekend travel, multiply the per-hour parking cost by two hours per day.
- **Toll Cost:** The toll costs may be relevant for some projects, particularly those likely to reduce driving on key bridges. If the route of the alternative transportation enables riders to avoid crossing a bridge (e.g., taking BART and avoiding the Bay Bridge), estimate avoided toll costs using the average bridge

[7] California Travel Reimbursement Rates. https://www.calhr.ca.gov/employees/Pages/travel-reimbursements.aspx

[8] Table 1 refers to commercial passenger air travel. For private aircraft, the State of California mileage reimbursement rate can be found at http://www.dot.ca.gov/hq/asc/travel/ch11/9priv_car.htm

[9] Auchincloss, A., Weinberger, R., Aytur, S., Namba1, A., and Ricchezza, A. (2015). Public Parking Fees and Fines: A Survey of U.S. Cities. Public Works Management & Policy. 20(1), 49–59. http://journals.sagepub.com/doi/pdf/10.1177/1087724X13514380

toll cost for passenger vehicles of $6 per trip[10] (i.e., Toll Rate) and multiply by the projected change in ridership on that portion of the route (i.e., Avoided Tolls).

- **User increase:** The user increase (i.e., the number of travelers switching from personal vehicle or plane to transit) is estimated by the applicant in order to quantify avoided VMT and GHG emission reductions using a CARB Quantification Methodology and Calculator Tools and is typically the increase in ridership multiplied by an adjustment factor.
- **Average Fare:** The average fare is specific to each transit agency and can be estimated using the system-wide average fare in the absence of more detailed information on passenger demographics and route choices (refer to Appendix B for information on average fare costs categorized by transit agency, transit mode, and type of service). If the system-wide average is unknown, a non-discounted adult fare can be used.
- **Voucher value:** The Voucher Value is the dollar value of an individual voucher provided by the project. If a project provides travel vouchers, the value of the vouchers contributes to the overall cost savings and are factored into the change in travel costs by multiplying the value of the individual vouchers (i.e., Voucher Value) by the number of travel vouchers distributed (i.e., Voucher Quantity).

When inputs required to estimate the travel cost savings are inputs to, or outputs from, a CARB GHG Quantification Methodology or Calculator Tool (e.g., avoided vehicle miles traveled), the values used in estimation of GHGs and co-benefits must be identical.

[10] Metropolitan Transportation Commission: Bay Area Toll Authority. https://mtc.ca.gov/about-mtc/authorities/bay-area-toll-authority-bata

Appendix A. Reference Table for Cost of Flying

Average cost per mile for commercial air travel between cities/metropolitan areas in California are presented below in Table 1.

Table 1. Average Cost Per Mile for Commercial Air Travel

Northern California Origins/Destinations	Southern California Origins/Destinations			
	Los Angeles Metro Area	Palm Springs	San Diego	Santa Barbara
San Francisco Metro Area	$0.36	$0.40	$0.32	$0.57
Fresno	--	--	$0.51	--
Sacramento	$0.32	$0.29	$0.28	--
Santa Rosa	$0.35	--	--	--

These per-mile costs used in this methodology and displayed in Table 1 are based on the passenger-weighted average city-pair commercial airfare and distance as tracked by the U.S. Department of Transportation.[11] For each pair of cities or metropolitan areas, the average one-way airfare is divided by the number of miles between cities, presented below in Table 2.

Table 2. Calculations Used to Derive Average Cost Per Mile

Northern California Origins/Destinations	Southern California Origins/Destinations			
	Los Angeles Metro Area	Palm Springs	San Diego	Santa Barbara
San Francisco Metro Area	$132.72 / 372 miles	$168.61 / 421 miles	$141.99 / 447 miles	$150.35 / 263 miles
Fresno	--	--	$161.17 / 314 miles	--
Sacramento	$130.31 / 404 miles	$129.38 / 439 miles	$134.56 / 480 miles	--
Santa Rosa	$152.80 / 433 miles	--	--	--

[11] Consumer Airfare Report, Table 1: Top 1,000 Contiguous State City-Pair Markets. This data is passenger-weighted from the 1st - 4th quarter of 2021. https://data.transportation.gov/Aviation/Consumer-Airfare-Report-Table-1-Top-1-000-Contiguo/4f3n-jbg2

Appendix B. Reference Table for Length of Average Trip and Average Fare Cost

CARB staff developed these recommended values for applicants to use for the length of the average unlinked passenger trip and baseline average fare cost, by agency or statewide, by mode, and by type of service using 2021 Annual data from the National Transit Database, supplemented by the previously used 2017 data for transit services that are absent from the 2021 data due to COVID-19 service interruptions or other reasons (identified in red italics)[12]. These values were calculated by dividing passenger miles traveled by unlinked passenger trips. Adjustment factors were developed by the Institute of Transportation Studies based on a review of research on transit dependency and data from the 2013 California Household Travel Survey[13].

[12] Federal Transit Administration. National Transit Database. Available at https://www.transit.dot.gov/ntd.

[13] Handy, Susan, Elisa Barbour, Alissa Kendall, Jamey Volker (2019) Updated Default Values for Transit Dependency and Average Length of Unlinked Transit Passenger Trips, for Calculations Using TAC Methods for California Climate Investments Programs. Institute of Transportation Studies, University of California, Davis. https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/transit_factors_technical_081319.pdf

Table 3. Length of Average Trip and Adjustment Factor by Mode

Mode Type	Mode	Type of Service	Average Trip Length (Miles/Trip)	Adjustment Factor
Commuter Bus (Express/Intercity)	CB	DO	23.15	0.705
		PT	22.61	
Cable Car	CC	DO	*1.26*	0.479
Commuter Rail	CR	DO	25.63	0.867
	CR	PT	33.55	0.867
Demand Response	DR	DO	5.81	0.540
		PT	8.88	
Demand Response Transportation Network Company	DR	TN	4.64	-
Demand Response Taxi	DR	TX	9.10	0.540
Ferryboat	FB	DO	12.01	1.00
		PT	23.70	
Heavy Rail	HR	DO	9.24	0.794
Light Rail	LR	DO	6.03	0.685
Bus (Local)	MB	DO	3.29	0.561 (Transit Bus) 0.585 (Shuttle)
		PT	4.20	
Monorail/Automated Guideway	MG	PT	3.18	0.479
Bus Rapid Transit	RB	DO	4.61	0.542
Streetcar Rail	SR	DO	*1.43*	0.479
Trolley Bus	TB	DO	1.53	0.479
Vanpool	VP	DO	31.72	0.879
		PT	48.56	
Hybrid Rail	YR	DO	6.86	0.738
	YR	PT	7.29	

Table 4. Length of Average Trip and Average Fare Cost by Transit Agency

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
Access Services	DR	TX	12.04	$2.56
Access Services	DR	PT	10.76	$2.41
Access Services	DT	PT	14.69	$2.39
Alameda-Contra Costa Transit District	CB	DO	13.68	$4.46
Alameda-Contra Costa Transit District	DR	PT	7.71	$2.60
Alameda-Contra Costa Transit District	MB	DO	3.89	$1.20
Alameda-Contra Costa Transit District	MB	PT	12.60	$1.21
Alameda-Contra Costa Transit District	RB	DO	3.07	$0.44
Altamont Corridor Express	CR	PT	55.57	$9.18
Anaheim Transportation Network	DR	PT	1.35	-
Anaheim Transportation Network	MB	PT	2.32	$0.80
Antelope Valley Transit Authority	CB	PT	56.54	$6.56
Antelope Valley Transit Authority	DR	PT	8.86	$1.23
Antelope Valley Transit Authority	MB	PT	5.41	$1.08
Butte County Association of Governments	DR	PT	2.89	$2.66
Butte County Association of Governments	MB	PT	4.92	$1.81
California Vanpool Authority	VP	DO	31.72	$3.49
Central Contra Costa Transit Authority	DR	PT	7.32	$1.96
Central Contra Costa Transit Authority	MB	DO	4.32	$0.97
Central Contra Costa Transit Authority	MB	PT	14.60	-
City and County of San Francisco	DR	PT	6.76	$2.39
City and County of San Francisco	LR	DO	0.74	$0.25
City and County of San Francisco	MB	DO	2.01	$0.32
City and County of San Francisco	TB	DO	1.53	$0.23
City of Commerce	DR	DO	4.99	-
City of Commerce	MB	DO	3.83	-
City of Culver City	DR	DO	1.69	$0.83
City of Culver City	MB	DO	4.43	$0.46
City of Elk Grove	CB	PT	14.06	$2.81
City of Elk Grove	DR	PT	4.68	$6.63
City of Elk Grove	MB	PT	3.44	$1.06
City of Fairfield, California	CB	PT	23.56	$3.90
City of Fairfield, California	DR	PT	10.18	$1.92
City of Fairfield, California	MB	PT	2.86	$0.40
City of Fresno	DR	PT	5.74	$1.22
City of Fresno	MB	DO	2.88	$0.31
City of Gardena	DR	DO	2.59	*$0.50*
City of Gardena	MB	DO	3.34	*$0.77*
City of Glendale	DR	PT	3.04	*$1.09*

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
City of Glendale	MB	PT	2.18	$0.01
City of La Mirada	DR	PT	2.34	$0.64
City of Los Angeles	CB	PT	10.91	$0.83
City of Los Angeles	DR	PT	3.81	$0.26
City of Los Angeles	DR	TX	2.38	$1.38
City of Los Angeles	MB	PT	1.19	*$0.37*
City of Modesto	DR	PT	4.50	$2.96
City of Modesto	DR	TX	5.33	$1.58
City of Modesto	MB	PT	4.19	$0.89
City of Montebello	DR	TX	1.80	$0.69
City of Montebello	MB	DO	3.30	$0.68
City of Montebello	MB	PT	2.47	$1.29
City of Norwalk	DR	PT	2.47	$0.69
City of Norwalk	MB	DO	4.20	*$0.88*
City of Pasadena	DR	PT	2.94	$0.13
City of Pasadena	MB	PT	1.99	$0.10
City of Petaluma	DR	PT	4.09	$1.02
City of Petaluma	MB	PT	2.73	$0.41
City of Redondo Beach	DR	PT	5.40	*$0.85*
City of Redondo Beach	MB	PT	3.60	*$0.84*
City of Riverside	DR	DO	5.63	$2.47
City of San Luis Obispo	MB	PT	3.10	$1.80
City of Santa Clarita	CB	PT	24.78	$0.86
City of Santa Clarita	DR	PT	6.54	$0.98
City of Santa Clarita	MB	PT	4.23	$0.15
City of Santa Maria	DR	PT	8.30	*$0.44*
City of Santa Maria	MB	PT	3.49	*$1.02*
City of Santa Monica	DR	PT	1.84	$0.57
City of Santa Monica	DR	TN	1.57	$0.57
City of Santa Monica	MB	DO	3.36	$0.40
City of Santa Rosa	DR	PT	3.99	$1.35
City of Santa Rosa	MB	DO	2.75	$0.29
City of Santa Rosa	MB	PT	3.61	$20.05
City of Torrance	DR	TX	3.47	$1.97
City of Torrance	MB	DO	4.95	$0.01
City of Tulare	DR	PT	4.21	$1.14
City of Tulare	MB	PT	6.06	$0.60
City of Turlock	DR	PT	7.09	$2.01
City of Turlock	MB	PT	3.34	$1.36
City of Visalia	CB	PT	51.99	$2.89

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
City of Visalia	DR	PT	6.38	$3.61
City of Visalia	MB	PT	6.68	$0.93
County of Placer	CB	PT	24.74	$6.61
County of Placer	DR	DO	10.80	$3.50
County of Placer	DR	PT	4.22	$0.82
County of Placer	MB	DO	7.76	$1.24
County of Placer	MB	PT	3.32	$0.64
County of Placer	VP	PT	33.91	$4.68
County of Sonoma	DR	PT	12.17	$0.71
County of Sonoma	MB	PT	8.33	$0.57
El Dorado County Transit Authority	CB	DO	31.03	$5.37
El Dorado County Transit Authority	DR	DO	11.22	$10.25
El Dorado County Transit Authority	MB	DO	8.97	$1.47
Foothill Transit	MB	PT	6.07	$0.66
Gold Coast Transit District	DR	PT	6.29	$0.73
Gold Coast Transit District	MB	DO	3.58	$0.15
Golden Empire Transit District	DR	DO	5.17	$6.13
Golden Empire Transit District	MB	DO	3.46	$0.87
Golden Gate Bridge, Highway and Transportation District	DR	PT	11.99	$5.67
Golden Gate Bridge, Highway and Transportation District	FB	DO	12.01	$9.44
Golden Gate Bridge, Highway and Transportation District	MB	DO	18.84	$6.22
Imperial County Transportation Commission	DR	PT	26.67	$2.48
Imperial County Transportation Commission	MB	PT	9.91	$0.05
Kings County Area Public Transit Agency	DR	PT	2.90	$2.42
Kings County Area Public Transit Agency	MB	PT	5.21	$1.02
Kings County Area Public Transit Agency	VP	PT	38.69	$3.70
Laguna Beach Municipal Transit	MB	DO	2.22	$0.04
Livermore / Amador Valley Transit Authority	DR	PT	4.75	$3.82
Livermore / Amador Valley Transit Authority	MB	PT	4.27	$1.98
Long Beach Transit	DR	PT	4.14	$1.67
Long Beach Transit	MB	DO	3.12	$0.01
Los Angeles County Metropolitan Transportation Authority	DR	DO	2.49	-

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
Los Angeles County Metropolitan Transportation Authority	HR	DO	5.24	$0.14
Los Angeles County Metropolitan Transportation Authority	LR	DO	6.61	$0.13
Los Angeles County Metropolitan Transportation Authority	MB	DO	2.86	$0.11
Los Angeles County Metropolitan Transportation Authority	MB	PT	3.79	$0.01
Los Angeles County Metropolitan Transportation Authority	RB	DO	5.85	$0.13
Los Angeles County Metropolitan Transportation Authority	VP	PT	46.98	$7.49
Marin County Transit District	DR	PT	6.77	$4.46
Marin County Transit District	MB	PT	5.63	$1.06
Metropolitan Transportation Commission	VP	PT	56.57	$7.43
Monterey-Salinas Transit	CB	DO	40.49	$16.91
Monterey-Salinas Transit	DR	PT	8.57	$1.23
Monterey-Salinas Transit	MB	DO	6.90	$1.42
Monterey-Salinas Transit	MB	PT	3.70	$1.27
Napa Valley Transportation Authority	CB	PT	16.63	$1.11
Napa Valley Transportation Authority	DR	PT	2.61	$3.21
Napa Valley Transportation Authority	MB	PT	9.54	$0.75
North County Transit District	CR	PT	26.44	$5.58
North County Transit District	DR	PT	13.48	$14.64
North County Transit District	MB	PT	4.34	$0.85
North County Transit District	YR	PT	7.29	$1.18
Omnitrans	DR	PT	9.85	$4.87
Omnitrans	MB	DO	5.63	$1.69
Omnitrans	MB	PT	3.77	$1.55
Orange County Transportation Authority	CB	DO	21.11	$1.68
Orange County Transportation Authority	CB	PT	19.28	$1.44
Orange County Transportation Authority	DR	PT	10.46	$4.26
Orange County Transportation Authority	DR	TX	4.76	$3.09
Orange County Transportation Authority	DT	PT	3.02	$3.44
Orange County Transportation Authority	MB	DO	4.41	$0.70
Orange County Transportation Authority	MB	PT	5.12	$0.53
Orange County Transportation Authority	VP	PT	36.82	$6.47
Paratransit, Inc.	DR	DO	9.82	*$4.20*
Paratransit, Inc.	DR	PT	10.46	$7.07
Paratransit, Inc.	DT	PT	8.37	$4.47

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
Peninsula Corridor Joint Powers Board dba: Caltrain	CR	PT	22.28	$25.68
Peninsula Corridor Joint Powers Board dba: Caltrain	MB	PT	3.47	-
Pomona Valley Transportation Authority	DR	PT	6.02	$0.33
Pomona Valley Transportation Authority	DR	TX	4.34	$1.45
Pomona Valley Transportation Authority	DT	PT	4.81	$1.94
Redding Area Bus Authority	DR	PT	6.36	$3.53
Redding Area Bus Authority	MB	PT	5.30	$1.14
Riverside County Transportation Commission	VP	PT	39.33	$6.72
Riverside Transit Agency	CB	DO	26.21	$1.56
Riverside Transit Agency	CB	PT	23.22	$2.08
Riverside Transit Agency	DR	PT	11.38	$5.13
Riverside Transit Agency	DT	PT	17.51	$4.05
Riverside Transit Agency	MB	DO	6.84	$0.73
Riverside Transit Agency	MB	PT	11.80	$1.52
Sacramento Regional Transit District	DR	DO	5.82	$3.58
Sacramento Regional Transit District	LR	DO	5.78	$1.43
Sacramento Regional Transit District	MB	DO	3.73	$1.38
San Bernardino County Transportation Authority	VP	PT	40.47	$7.66
San Diego Association of Governments	VP	PT	55.11	$6.61
San Diego Metropolitan Transit System	CB	PT	26.10	$6.78
San Diego Metropolitan Transit System	DR	PT	10.04	$4.26
San Diego Metropolitan Transit System	DR	TX	12.05	$4.58
San Diego Metropolitan Transit System	LR	DO	6.32	$0.99
San Diego Metropolitan Transit System	MB	DO	5.32	$1.68
San Diego Metropolitan Transit System	MB	PT	3.86	$1.23
San Francisco Bay Area Rapid Transit District	HR	DO	13.65	$3.50
San Francisco Bay Area Rapid Transit District	MG	PT	3.18	$5.78
San Francisco Bay Area Rapid Transit District	YR	DO	6.86	$2.88
San Francisco Bay Area Water Emergency Transportation Authority	FB	PT	23.70	$7.32
San Francisco Municipal Railway	CC	DO	1.26	$4.34
San Francisco Municipal Railway	DR	PT	6.17	$2.29
San Francisco Municipal Railway	LR	DO	2.73	$0.77

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
San Francisco Municipal Railway	MB	DO	2.15	$0.77
San Francisco Municipal Railway	SR	DO	1.43	$0.77
San Francisco Municipal Railway	TB	DO	1.48	$0.77
San Joaquin Council	VP	PT	47.37	$7.05
San Joaquin Regional Transit District	CB	PT	44.32	$5.30
San Joaquin Regional Transit District	DR	PT	7.29	$3.97
San Joaquin Regional Transit District	DR	TX	5.13	$4.77
San Joaquin Regional Transit District	DT	PT	5.83	$3.73
San Joaquin Regional Transit District	MB	DO	3.51	$0.66
San Joaquin Regional Transit District	MB	PT	4.55	$0.59
San Luis Obispo Regional Transit Authority	DR	DO	7.11	$3.12
San Luis Obispo Regional Transit Authority	MB	DO	12.09	$0.62
San Mateo County Transit District	DR	PT	8.14	$2.08
San Mateo County Transit District	DR	TX	15.51	$1.73
San Mateo County Transit District	DT	PT	11.89	$2.38
San Mateo County Transit District	MB	DO	3.57	$1.15
San Mateo County Transit District	MB	PT	5.20	$1.30
Santa Barbara Metropolitan Transit District	MB	DO	4.09	$0.17
Santa Clara Valley Transportation Authority	DR	PT	8.08	$2.71
Santa Clara Valley Transportation Authority	DT	PT	10.68	$2.86
Santa Clara Valley Transportation Authority	LR	DO	6.44	$1.10
Santa Clara Valley Transportation Authority	MB	DO	5.00	$1.10
Santa Clara Valley Transportation Authority	MB	PT	4.50	$2.65
Santa Cruz Metropolitan Transit District	CB	DO	30.59	$4.43
Santa Cruz Metropolitan Transit District	DR	DO	6.36	$2.95
Santa Cruz Metropolitan Transit District	DT	PT	7.23	$2.09
Santa Cruz Metropolitan Transit District	MB	DO	4.41	$4.70
Solano County Transit	CB	PT	13.78	$4.17
Solano County Transit	DR	PT	3.59	$3.72
Solano County Transit	MB	PT	2.82	$1.22
Sonoma-Marin Area Rail Transit District	CR	DO	25.63	$5.75
Southern California Regional Rail Authority	CR	PT	39.20	$7.73
SunLine Transit Agency	DR	DO	8.00	$1.37
SunLine Transit Agency	MB	DO	6.05	$0.12
SunLine Transit Agency	VP	PT	57.99	$7.50

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
The Eastern Contra Costa Transit Authority	DR	PT	4.74	$4.18
The Eastern Contra Costa Transit Authority	DR	TN	6.17	$4.00
The Eastern Contra Costa Transit Authority	MB	PT	4.52	$0.37
Transit Joint Powers Authority for Merced County	DR	PT	5.87	$0.92
Transit Joint Powers Authority for Merced County	MB	PT	6.36	$1.63
University of California, Davis (Unitrans)	MB	DO	2.16	$12.78
Ventura County Transportation Commission	CB	PT	26.77	*$1.60*
Ventura County Transportation Commission	DR	PT	2.80	*$1.75*
Ventura County Transportation Commission	MB	PT	4.37	*$0.85*
Victor Valley Transit Authority	CB	PT	52.89	$13.08
Victor Valley Transit Authority	DR	PT	13.92	$3.29
Victor Valley Transit Authority	MB	PT	6.85	$1.52
Victor Valley Transit Authority	VP	PT	45.48	$6.23
Western Contra Costa Transit Authority	CB	PT	28.39	$1.79
Western Contra Costa Transit Authority	DR	PT	6.08	$0.59
Western Contra Costa Transit Authority	MB	PT	6.27	$0.42
Yolo County Transportation District	DR	PT	11.29	$4.83
Yolo County Transportation District	MB	PT	11.50	$2.54
Yuba-Sutter Transit Authority	CB	PT	39.30	$6.69
Yuba-Sutter Transit Authority	DR	PT	5.86	$5.67
Yuba-Sutter Transit Authority	MB	PT	3.04	$1.04

Appendix C. Example Methods and Data Inputs for Transit Expansion Projects

The following is a hypothetical project[14] to demonstrate how the Travel Cost Savings Co-benefit Assessment Methodology would be used to estimate the benefits of a Transit and Intercity Rail Capital Program project. This example does not include the supporting documentation that may be required of actual project applicants.

Overview of the Proposed Project

The applicant is proposing the following project components:

- Expand capacity of the regional (commuter) transit orange and purple line by purchasing ten railcars and extending the existing daily light rail service for one year.

The proposed project has the following relevant project features:

- The proposed project is located in Sacramento County;
- Daily ridership will increase by 350 unlinked trips;
- Daily light rail service will be extended by 35.5 miles;
- Length of the average unlinked trip will be 5.66 miles;
- Total avoided VMT is 357,700 miles, per the CARB GHG Quantification Methodology and Calculator Tool;
- According to agency estimates, the average per-person one-way fare is $1.30;
- According to the lookup table in Appendix B, the adjustment factor for light rail systems is 68.5%
- According to agency estimates, 20% of the new ridership will avoid parking downtown for work on weekdays and 15% will avoid parking downtown for shopping and errands on weekends;
- No paid parking at the transit facility where the service line originates; and
- The project quantification period is one year, per the CARB GHG Quantification Methodology and Calculator Tool.

Methods to Apply

In this example, there is no avoided air travel, tolls, or active transportation costs so the relevant equation components to use are:

$$Travel\ Cost\ Savings_{Mode\ Shift} = (Travel\ Cost\ of\ Baseline\ Mode - Travel\ Cost\ of\ New\ Mode) \times Adjustment\ Factor \times Quantification\ Period$$

[14] The hypothetical project has not undergone verification of any program requirements; all assumptions about location type and features are for demonstration purposes only.

Where:

$$Travel\ Cost\ of\ Baseline\ Mode = Transportation\ Cost_{Baseline} + Parking\ Cost_{Baseline}$$

and,

$$Travel\ Cost\ of\ New\ Mode = Transit\ Cost_{New}$$

Step 1: Calculate the Travel Cost of Baseline Mode

$$Transportation\ Cost_{Baseline} = Cost\ Per\ Mile_{Baseline} \times Miles_{Baseline}$$

$$Transportation\ Cost_{Baseline} = 0.605\frac{Dollars}{Mile} \times 357{,}700\frac{Miles}{Year} = \$216{,}409\ per\ year$$

$$Parking\ Cost_{Baseline} = Avoided\ Parking_{Wd} \times Parking\ Cost_{Wd} + Avoided\ Parking_{We} \times Parking\ Cost_{We}$$

$$Parking\ Cost_{Baseline} = \left(20\% \times \frac{350\frac{Trip}{Day}}{2} \times 5\frac{Days}{Week} \times 52\frac{Weeks}{Year}\right) \times \left(11.13\frac{Dollars}{Trip}\right)$$

$$+\left(15\% \times \frac{350\frac{Trip}{Day}}{2} \times 2\frac{Days}{Week} \times 52\frac{Weeks}{Year}\right) \times \left(1.50\frac{Dollars}{Hour} \times 2\frac{Hours}{Trip}\right.$$

$$= 9{,}100\ \frac{Trips}{Year} \times 11.13\frac{Dollars}{Trip} + 2{,}730\frac{Trips}{Year} \times 3\frac{Dollars}{Trip}$$

$$= \$109{,}473\ per\ year$$

$$Travel\ Cost\ of\ Baseline\ Mode = \$216{,}409\ per\ year + \$109{,}473\ per\ year$$
$$= \$325{,}882\ per\ year$$

Step 2: Calculate the Travel Cost of New Mode

$$Transit\ Cost_{New} = User\ Increase \times Average\ Fare$$

$$Transit\ Cost_{New} = \left(350\ \frac{Trips}{Day} \times 365\frac{Days}{Year}\right) \times 1.30\frac{Dollars}{Trip}$$

$$= 127{,}750\frac{Trips}{Year} \times 1.30\frac{Dollars}{Trip} = \$113{,}762\ per\ year$$

$$Travel\ Cost\ of\ New\ Mode = \$166{,}075\ per\ year$$

Step 3: Calculate the Travel Cost Savings

$$Travel\ Cost\ Savings = (\$325{,}882\ per\ year - \$166{,}075\ per\ year)$$
$$\times 0.685\ Adjustment\ Factor \times 1\ year$$
$$= \$109{,}468$$

In this example, it is estimated that the project would result in travel cost savings for transit riders of $109,468 during the one-year project quantification period.

Appendix D. Example Methods and Data Inputs for Transit Fare Reduction Projects

The following is a hypothetical project[15] to demonstrate how the Travel Cost Savings Co-benefit Assessment Methodology would be used to estimate the benefits of a Transit and Intercity Rail Capital Program project. This example does not include the supporting documentation that may be required of actual project applicants.

Overview of the Proposed Project

The applicant is proposing the following project components:

- Reduce fare costs for low-income riders on the local transit bus blue line.

The proposed project has the following relevant project features:

- The proposed project is located in Los Angeles County;
- Daily ridership will increase by 116 unlinked trips;
- Daily bus service length is 12 miles;
- Length of the average unlinked trip will be 3.20 miles;
- Total avoided VMT is 128,300 miles, per the CARB GHG Quantification Methodology and Calculator Tool;
- The per-person one-way fare will be reduced from $2.00 to $0.75;
- According to the lookup table in Appendix B, the adjustment factor for local transit bus systems is 56.1%
- According to agency estimates, 30% of the new ridership will avoid parking downtown for work on weekdays and 20% will avoid parking downtown for shopping and errands on weekends;
- No paid parking at the transit facility where the service line originates; and
- The project quantification period is two years, per the CARB GHG Quantification Methodology and Calculator Tool.

Methods to Apply

In this example, there are no transit vouchers so the relevant equation components to use are:

$$Travel\ Cost\ Savings_{Travel\ Subsidy} = Travel\ Cost\ Savings_{Mode\ Shift} + Travel\ Cost\ Savings_{Fare\ Reduction} \times (1 - Adjustment\ Factor) \times Quantification\ Period$$

[15] The hypothetical project has not undergone verification of any program requirements; all assumptions about location type and features are for demonstration purposes only.

There is no avoided air travel, tolls, transit vouchers or active transportation costs so the relevant equation components to use for travel cost savings related to mode shift are:

$$Travel\ Cost\ Savings_{Mode\ Shift} = (Travel\ Cost\ of\ Baseline\ Mode - Travel\ Cost\ of\ New\ Mode) \times Adjustment\ Factor \times Quantification\ Period$$

Where:

$$Travel\ Cost\ of\ Baseline\ Mode = Transportation\ Cost_{Baseline} + Parking\ Cost_{Baseline}$$

and,

$$Travel\ Cost\ of\ New\ Mode = Transit\ Cost_{New}$$

Step 1: Calculate the Travel Cost of Baseline Mode

$$Transportation\ Cost_{Baseline} = Cost\ Per\ Mile_{Baseline} \times Miles_{Baseline}$$

$$Transportation\ Cost_{Baseline} = 0.605\frac{Dollars}{Mile} \times 128{,}300\frac{Miles}{Year} = \$77{,}622\ per\ year$$

$$Parking\ Cost_{Baseline} = Avoided\ Parking_{Wd} \times Parking\ Cost_{Wd} + Avoided\ Parking_{We} \times Parking\ Cost_{We}$$

$$Parking\ Cost_{Baseline} = \left(30\% \times \frac{116\frac{Trip}{Day}}{2} \times 5\frac{Days}{Week} \times 52\frac{Weeks}{Year}\right) \times \left(11.13\frac{Dollars}{Trip}\right) + \left(20\% \times \frac{116\frac{Trip}{Day}}{2} \times 2\frac{Days}{Week} \times 52\frac{Weeks}{Year}\right) \times \left(1.50\frac{Dollars}{Hour} \times 2\frac{Hours}{Trip}\right.$$

$$= 9{,}048\ \frac{Trips}{Year} \times 11.13\frac{Dollars}{Trip} + 2{,}413\frac{Trips}{Year} \times 3\frac{Dollars}{Trip}$$

$$= \$107{,}943\ per\ year$$

$$Travel\ Cost\ of\ Baseline\ Mode = \$77{,}622\ per\ year + \$107{,}943\ per\ year = \$185{,}565\ per\ year$$

Step 2: Calculate the Travel Cost of New Mode

$$Transit\ Cost_{New} = User\ Increase \times Average\ Fare$$

$$Transit\ Cost_{New} = \left(116\ \frac{Trips}{Day} \times 365\frac{Days}{Year}\right) \times 0.75\frac{Dollars}{Trip}$$

$$= 42{,}340\frac{Trips}{Year} \times 0.75\frac{Dollars}{Trip} = \$31{,}755\ per\ year$$

$$Travel\ Cost\ of\ New\ Mode = \$31{,}755\ per\ year$$

Step 3: Calculate the Travel Cost Savings from Mode Shift

$$\begin{aligned} Travel\ Cost\ Savings_{Mode\ Shift} &= (\$185{,}565\ per\ year - \$31{,}755\ per\ year) \\ &\quad \times 0.561\ Adjustment\ Factor \times 2\ years \\ &= \$172{,}575 \end{aligned}$$

Step 4: Calculate the Travel Cost Savings from Fare Reduction

$$\begin{aligned} Travel\ Cost\ Savings_{Fare\ Reduction} &= Users \times (Baseline\ Fare\ Cost - New\ Fare\ Cost) \\ &= \left(116\ \frac{Trips}{Day} \times 365\ \frac{Days}{Year}\right) \\ &\quad \times \left(2.00\ \frac{Dollars}{Trip} - 0.75\ \frac{Dollars}{Trip}\right) \\ &= \$52{,}925\ per\ year \end{aligned}$$

Step 5: Calculate the Travel Cost Savings from Travel Subsidy

$$\begin{aligned} Travel\ Cost\ Savings_{Travel\ Subsidy} &= Travel\ Cost\ Savings_{Mode\ Shift} \\ &\quad + Travel\ Cost\ Savings_{Fare\ Reduction} \\ &\quad \times (1 - Adjustment\ Factor) \times Quantification\ Period \\ &= \$172{,}575 + \$74{,}095\ per\ year \\ &\quad \times (1 - 0.561\ Adjustment\ Factor) \times 2\ years \\ &= \$151{,}521 + \$65{,}055 \\ &= \$216{,}576 \end{aligned}$$

In this example, it is estimated that the project would result in travel cost savings for transit riders of $216,576 during the two-year project quantification period.

Appendix E. Example Methods and Data Inputs for Active Transportation Projects

The following is a hypothetical project[16] to demonstrate how the Travel Cost Savings Co-benefit Assessment Methodology would be used to estimate the benefits of an Active Transportation Program project. This example does not include the supporting documentation that may be required of actual project applicants.

Overview of the Proposed Project

The applicant is proposing the following project components:

- New construction of 1 mile of Class II bike lane.

The proposed project has the following relevant project features:

- Total avoided VMT is 15,120 miles per year, per the CARB GHG Quantification Methodology and Calculator Tool; and
- The project quantification period is 15 years, per the CARB GHG Quantification Methodology and Calculator Tool.

Methods to Apply

In this example, there is no avoided air travel, parking costs, or tolls, no increased transit system ridership, and no transit vouchers so the relevant equations to use are:

$$Travel\ Cost\ Savings_{Mode\ Shift} = (Travel\ Cost\ of\ Baseline\ Mode - Travel\ Cost\ of\ New\ Mode) \times Adjustment\ Factor \times Quantification\ Period$$

Where:

$$Travel\ Cost\ of\ Baseline\ Mode = Transportation\ Cost_{Baseline}$$

and,

$$Travel\ Cost\ of\ New\ Mode = Active\ Transportation\ Cost_{New}$$

Step 1: Calculate the Travel Cost of Baseline Mode

$$Transportation\ Cost_{Baseline} = Cost\ Per\ Mile_{Baseline} \times Miles_{Baseline} = 0.605\ \frac{Dollars}{Mile} \times 15{,}120\ \frac{Miles}{Year} = \$9{,}147.60\ per\ year$$

[16] The hypothetical project has not undergone verification of any program requirements; all assumptions about location type and features are for demonstration purposes only.

Step 2: Calculate the Travel Cost of New Mode

$$Active\ Transportation\ Cost_{New} = Cost\ Per\ Mile_{Active} \times Miles_{Active}$$
$$= 0.04 \frac{Dollars}{Mile} \times 15{,}120\ \frac{Miles}{Year} = \$604.80\ per\ year$$

Step 3: Calculate the Travel Cost Savings

$$Travel\ Cost\ Savings = (\$9{,}147.60\ per\ year - \$604.80\ per\ year) \times 15\ years$$
$$= \$128{,}142$$

In this example, it is estimated that the project would result in travel cost savings for active transportation users of $128,142 during the 15-year project quantification period.

Bibliography

Auchincloss, A., Weinberger, R., Aytur, S., Namba1, A., and Ricchezza, A. (2015). Public Parking Fees and Fines: A Survey of U.S. Cities. Public Works Management & Policy. 20(1), 49–59. Available at: http://journals.sagepub.com/doi/pdf/10.1177/1087724X13514380

Bay Area Toll Authority. (2019). Auto Tolls available at: https://mtc.ca.gov/about-mtc/what-mtc/bay-area-toll-authority-bata

California Department of Human Resoures. (2019). Mileage Reimbursement Rates. Available at: https://www.calhr.ca.gov/employees/Pages/travel-reimbursements.aspx.

Federal Transit Administration. National Transit Database. (2022). Available at: https://www.transit.dot.gov/ntd.

U.S. Department of Transportation. Consumer Airfare Report, Table 1: Top 1,000 Contiguous State City-Pair Markets. (2022). This data is passenger-weighted from the 1st to 4th quarter of 2021. Available at: https://data.transportation.gov/Aviation/Consumer-Airfare-Report-Table-1-Top-1-000-Contiguo/4f3n-jbg2.