

**California Air Resources Board**

**Co-benefit Assessment Methodology  
Travel Cost Savings**

**California Climate Investments  
Greenhouse Gas Reduction Fund**



**FINAL  
October 18, 2019**

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## 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
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](http://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<sup>1</sup> projects that involve:

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

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.<sup>2</sup>

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<sup>3</sup> and are not included here to avoid double-counting of co-benefits.

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<sup>1</sup> 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.

<sup>2</sup> To avoid double counting, each project component should be calculated in only one project category.

<sup>3</sup> California Air Resources Board. Energy and Fuel Cost Savings Co-benefit Assessment Methodology. [www.arb.ca.gov/cci-cobenefits](http://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](http://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 staff periodically review each methodology to evaluate its 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 versions to enhance the analysis and provide additional clarity, including the following additions:

- Providing more detailed methods for calculating Travel Cost Savings, depending upon the project category (Mode Shift or Travel Subsidies);
- Factoring in an adjustment factor for transit non-dependency;
- Adding default trip lengths and adjustment factors for transit and active transportation components; and
- Adding default trip lengths and fare costs by transit agency and transit mode.

CARB released the Draft Travel Cost Savings Co-benefit Assessment Methodology for public comment in September 2019. 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.

## **Program Assistance**

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

## 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<sup>4</sup> 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

$\text{Travel Cost Savings}_{\text{Mode Shift}} = (\text{Travel Cost of Baseline Mode} - \text{Travel Cost of New Mode}) \times \text{Adjustment Factor} \times \text{Quantification Period}$		
Where,		
Travel Cost Savings <sub>Mode Shift</sub>	= 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.	<u>Units</u> \$
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

<sup>4</sup> 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 air planes. 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,

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

Transportation Cost <sub>Baseline</sub>	= Annual cost of airfare or the cost to operate the vehicle for the length of the trip(s)	<u>Units</u> \$/year
Cost per Mile <sub>Baseline</sub>	= Cost per mile of airfare or to operate the vehicle	\$/mile
Miles <sub>Baseline</sub>	= 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**

$$\text{Parking Cost}_{\text{Baseline}} = \text{Avoided Parking}_{\text{Wd}} \times \text{Parking Cost}_{\text{Baseline, Wd}} + \text{Avoided Parking}_{\text{Baseline, We}} \times \text{Parking Cost}_{\text{We}}$$

Where,

		<u>Units</u>
Parking Cost <sub>Baseline</sub>	= Annual cost of parking associated with baseline trip(s)	\$/year
Avoided Parking <sub>Wd</sub>	= Annual expected avoided parking on weekdays associated with the increase in transit ridership, bike trips, or pedestrian trips	roundtrips/yr
Parking Cost <sub>Baseline, Wd</sub>	= Weekday cost for parking associated with baseline trip(s)	\$/trip
Avoided Parking <sub>We</sub>	= Annual expected avoided parking on weekends associated with the increase in transit ridership, bike trips, or pedestrian trips	roundtrips/yr
Parking Cost <sub>Baseline, We</sub>	= 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**

$$\text{Toll Cost}_{\text{Base}} = \text{Avoided Tolls} \times \text{Toll Rate}$$

Where,

		<u>Units</u>
Toll Cost <sub>Baseline</sub>	= 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**

$\text{Travel Cost of New Mode} = \text{Transit Cost}_{New} + \text{Mobility Cost}_{New} + \text{Parking Cost}_{New} + \text{Active Transportation Cost}_{New}$		
Where,		
Travel Cost of New Mode	= Annual estimated cost of the new mode of travel as a result of the project.	Units \$/year
Transit Cost <sub>New</sub>	= Annual cost of transit fares associated with the increase in ridership	\$/year
Mobility Cost <sub>New</sub>	= Annual cost of car share, vanpool, rideshare and other mobility options associated with the increase in use	\$/year
Parking Cost <sub>New</sub>	= Annual cost of parking associated with new trip(s), e.g., parking at a transit facility	\$/year
Active Transportation Cost <sub>New</sub>	= 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<sup>5</sup> 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**

$\text{Transit Cost}_{New} = \text{User Increase} \times \text{Average Fare}$		
Where,		
Transit Cost <sub>New</sub>	= Annual cost of transit fares associated with the increase in ridership	Units \$/year
User Increase	= Annual expected increase in transit ridership	trips/year
Average Fare	= Average transit system one-way fare	\$/trip

<sup>5</sup> 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,

Mobility Cost <sub>New</sub>	= Annual cost of car share, vanpool, rideshare and other mobility options associated with the increase in use	<u>Units</u> \$/year
User Increase <sub>Service</sub>	= Expected increase in use, by mobility service type	trips/year
Average Fare <sub>Service</sub>	= 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,

Parking Cost <sub>New</sub>	= Annual cost of parking associated with new mode trip(s)	<u>Units</u> \$/year
Parking <sub>Wd</sub>	= Annual expected parking on weekdays associated with the increase in transit ridership	roundtrips/yr
Parking Cost <sub>New,Wd</sub>	= Weekday cost for parking associated with new mode trip(s)	\$/trip
Parking <sub>We</sub>	= Annual expected parking on weekends associated with the increase in transit ridership	roundtrips/yr
Cost <sub>New,We</sub>	= 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,

Active Transportation Cost <sub>New</sub>	= Annual cost to operate the mode of active transportation (e.g., bicycle, scooter) for the length of the trip(s)	<u>Units</u> \$/year
Cost Per Mile <sub>Active</sub>	= Cost per mile to operate the mode of active transportation	\$/mile
Miles <sub>Active</sub>	= 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,		
Travel Cost Savings <sub>Travel Subsidy</sub>	= 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.	<u>Units</u> \$
Travel Cost Savings <sub>Mode Shift</sub>	= 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 <sub>Fare Reduction</sub>	= Travel cost savings associated with fare reductions	\$/year
Travel Cost Savings <sub>Voucher</sub>	= Travel cost savings associated with travel vouchers provided by the project	\$/year
Adjustment Factor <sub>Travel Subsidy</sub>	= 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,

Travel Cost Savings <sub>Fare Reduction</sub>	=	Travel cost savings associated with fare reductions	<u>Units</u> \$/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,

Travel Cost Savings <sub>Voucher</sub>	=	Travel cost savings associated with travel vouchers provided by the project	<u>Units</u> \$/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. As of January 1, 2019, the State of California mileage reimbursement rate for personal vehicles and bicycles is 58 cents per mile and 4 cents per mile, respectively.<sup>6</sup> The cost per mile rate for flying is estimated using the default values from Table 1 in Appendix A.<sup>7</sup> 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.<sup>8</sup> 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

<sup>6</sup> California Travel Reimbursement Rates. <https://www.calhr.ca.gov/employees/Pages/travel-reimbursements.aspx>

<sup>7</sup> 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](http://www.dot.ca.gov/hq/asc/travel/ch11/9priv_car.htm)

<sup>8</sup> 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<sup>9</sup> (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.

<sup>9</sup> Metropolitan Transportation Commission: Bay Area Toll Authority. <https://mtc.ca.gov/about-mtc/what-mtc/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
San Francisco Metro Area	\$0.34	\$0.43	\$0.29
Fresno	--	--	\$0.47
Sacramento	\$0.34	--	\$0.26
Santa Rosa	\$0.34	--	--

These per-mile costs used in this methodology and displayed in Table 1 are based on the average city-pair commercial airfare and distance as tracked by the U.S. Department of Transportation.<sup>10</sup> 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
San Francisco Metro Area	\$125.50 / 372 miles	\$182.25 / 421 miles	\$128.25 / 447 miles
Fresno	--	--	\$146.25 / 314 miles
Sacramento	\$135.50 / 404 miles	--	\$125.25 / 480 miles
Santa Rosa	\$147 / 433 miles	--	--

<sup>10</sup> Consumer Airfare Report, Table 1: Top 1,000 Contiguous State City-Pair Markets. This data is from the 1<sup>st</sup> - 4<sup>th</sup> quarter of 2018. <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 2017 Annual data from the National Transit Database<sup>11</sup>. 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<sup>12</sup>.

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

Mode Type	Mode	Type of Service	Length of Average Trip (Miles/Trip)	Adjustment Factor
Commuter Bus (Express/Intercity)	CB	DO	17.57	70.5
		PT	21.83	
Cable Car	CC	DO	1.26	47.9
Commuter Rail	CR	PT	25.69	86.7
Demand Response	DR	DO	9.08	54.0
		PT	9.94	
Demand Response Taxi	DT	PT	12.35	54.0
Ferryboat	FB	DO	10.85	100
		PT	15.01	
Heavy Rail	HR	DO	11.48	79.4
Light Rail	LR	DO	5.44	68.5
Bus (Local)	MB	DO	3.77	56.1 (Transit Bus) 58.5 (Shuttle)
		PT	4.27	
Monorail/Automated Guideway	MG	PT	3.18	47.9
Bus Rapid Transit	RB	DO	6.56	54.2
Streetcar Rail	SR	DO	1.43	47.9
Trolley Bus	TB	DO	1.48	47.9
Vanpool	VP	DO	42.28	87.9
		PT	44.27	
Hybrid Rail	YR	PT	8.58	73.8

<sup>11</sup> Federal Transit Administration. National Transit Database. Available at <https://www.transit.dot.gov/ntd>.

<sup>12</sup> 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](https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/transit_factors_technical_081319.pdf)

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	PT	11.47	\$2.22
Access Services	DT	PT	14.69	\$2.39
Alameda-Contra Costa Transit District	CB	DO	14.19	\$2.49
Alameda-Contra Costa Transit District	DR	PT	10.47	\$3.81
Alameda-Contra Costa Transit District	MB	DO	3.28	\$1.36
Alameda-Contra Costa Transit District	MB	PT	13.03	\$2.48
Altamont Corridor Express	CR	PT	42.86	\$6.85
Anaheim Transportation Network	MB	PT	1.98	\$0.55
Antelope Valley Transit Authority	CB	PT	42.05	\$8.53
Antelope Valley Transit Authority	DR	PT	9.18	\$2.21
Antelope Valley Transit Authority	MB	PT	7.15	\$1.13
Butte County Association of Governments	DR	PT	4.33	\$2.09
Butte County Association of Governments	MB	PT	4.92	\$1.11
California Vanpool Authority	VP	DO	42.28	\$3.27
Central Contra Costa Transit Authority	DR	PT	9.89	\$3.55
Central Contra Costa Transit Authority	MB	DO	4.54	\$1.12
City of Commerce Municipal Buslines	DR	DO	9.36	\$0.00
City of Commerce Municipal Buslines	MB	DO	4.03	\$0.00
City of Elk Grove	CB	PT	13.46	\$1.80
City of Elk Grove	DR	PT	6.27	\$5.17
City of Elk Grove	MB	PT	4.00	\$1.34
City of Fairfield - Fairfield and Suisun Transit	CB	PT	20.40	\$3.88
City of Fairfield - Fairfield and Suisun Transit	DR	PT	9.63	\$4.94
City of Fairfield - Fairfield and Suisun Transit	MB	PT	3.17	\$1.03
City of Gardena Transportation Department	DR	DO	3.17	\$0.50
City of Gardena Transportation Department	MB	DO	3.20	\$0.77
City of Glendale	DR	PT	5.26	\$1.09
City of Glendale	MB	PT	2.20	\$0.62
City of La Mirada Transit	DR	PT	2.86	\$0.77
City of Los Angeles Department of Transportation	CB	PT	17.00	\$3.03
City of Los Angeles Department of Transportation	DR	PT	4.69	\$0.92

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
City of Los Angeles Department of Transportation	DT	PT	2.18	\$2.77
City of Los Angeles Department of Transportation	MB	PT	1.55	\$0.37
City of Petaluma	DR	PT	3.90	\$2.23
City of Petaluma	MB	PT	2.76	\$0.64
City of Redondo Beach - Beach Cities Transit	DR	PT	4.43	\$0.85
City of Redondo Beach - Beach Cities Transit	MB	PT	4.10	\$0.84
City of Riverside Special Transportation	DR	DO	7.79	\$2.11
City of San Luis Obispo	MB	PT	3.10	\$0.62
City of Santa Rosa	DR	PT	5.46	\$3.13
City of Santa Rosa	MB	DO	3.94	\$0.77
City of Santa Rosa	MB	PT	3.00	\$10.28
City of Tulare	DR	PT	5.38	\$2.27
City of Tulare	MB	PT	4.36	\$0.84
City of Turlock	DR	PT	7.42	\$3.01
City of Turlock	MB	PT	3.33	\$0.56
City of Visalia - Visalia City Coach	CB	PT	45.01	\$7.69
City of Visalia - Visalia City Coach	DR	PT	7.69	\$3.93
City of Visalia - Visalia City Coach	MB	PT	6.26	\$0.90
Culver City Municipal Bus Lines	DR	DO	2.03	\$0.45
Culver City Municipal Bus Lines	MB	DO	3.33	\$0.63
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	7.62	\$1.19
Fresno Area Express	DR	PT	7.30	\$1.30
Fresno Area Express	MB	DO	2.60	\$0.79
Gold Coast Transit	DR	PT	7.45	\$2.62
Gold Coast Transit	MB	DO	4.25	\$0.81
Golden Empire Transit District	DR	DO	6.48	\$2.69
Golden Empire Transit District	MB	DO	3.59	\$0.84
Golden Gate Bridge, Highway and Transportation District	DR	PT	11.82	\$4.09
Golden Gate Bridge, Highway and Transportation District	FB	DO	10.85	\$8.05
Golden Gate Bridge, Highway and Transportation District	MB	DO	18.65	\$4.79

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
Imperial County Transportation Commission	DR	PT	18.47	\$2.09
Imperial County Transportation Commission	MB	PT	9.91	\$0.83
Kings County Area Public Transit Agency	DR	PT	3.75	\$1.92
Kings County Area Public Transit Agency	MB	PT	6.46	\$0.73
Laguna Beach Municipal Transit	MB	DO	2.22	\$0.04
Livermore / Amador Valley Transit Authority	DR	PT	6.02	\$4.14
Livermore / Amador Valley Transit Authority	MB	PT	4.62	\$1.22
Long Beach Transit	DR	PT	4.76	\$1.66
Long Beach Transit	MB	DO	3.23	\$0.61
Los Angeles County Metropolitan Transportation Authority dba: Metro	HR	DO	5.00	\$0.78
Los Angeles County Metropolitan Transportation Authority dba: Metro	LR	DO	7.31	\$0.78
Los Angeles County Metropolitan Transportation Authority dba: Metro	MB	DO	4.03	\$0.82
Los Angeles County Metropolitan Transportation Authority dba: Metro	MB	PT	4.72	\$0.43
Los Angeles County Metropolitan Transportation Authority dba: Metro	RB	DO	6.56	\$0.78
Los Angeles County Metropolitan Transportation Authority dba: Metro	VP	PT	44.79	\$3.93
Marin County Transit District	DR	PT	8.10	\$3.33
Marin County Transit District	MB	PT	4.09	\$1.08
Modesto Area Express	DR	PT	6.84	\$2.87
Modesto Area Express	DT	PT	4.90	\$1.69
Modesto Area Express	MB	PT	4.26	\$0.89
Montebello Bus Lines	DT	PT	2.16	\$0.29
Montebello Bus Lines	MB	DO	3.25	\$0.76
Montebello Bus Lines	MB	PT	2.90	\$1.20
Monterey-Salinas Transit	CB	DO	40.49	\$16.91
Monterey-Salinas Transit	DR	PT	8.58	\$2.59
Monterey-Salinas Transit	MB	DO	6.21	\$2.14
Monterey-Salinas Transit	MB	PT	3.71	\$1.92
Napa Valley Transportation Authority	CB	PT	30.84	\$2.33
Napa Valley Transportation Authority	DR	PT	7.19	\$2.43
Napa Valley Transportation Authority	MB	PT	7.42	\$0.69

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
North County Transit District	CR	PT	26.44	\$4.04
North County Transit District	DR	PT	12.97	\$3.83
North County Transit District	MB	PT	4.32	\$0.95
North County Transit District	YR	PT	8.58	\$1.06
Norwalk Transit System	DR	PT	3.41	\$1.14
Norwalk Transit System	MB	DO	4.19	\$0.88
Omnitrans	DR	PT	14.01	\$3.78
Omnitrans	MB	DO	5.14	\$1.01
Omnitrans	MB	PT	3.12	\$1.08
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	11.29	\$4.42
Orange County Transportation Authority	DT	PT	3.02	\$3.44
Orange County Transportation Authority	MB	DO	3.35	\$0.99
Orange County Transportation Authority	MB	PT	3.88	\$0.97
Orange County Transportation Authority	VP	PT	34.51	\$3.95
Paratransit, Inc.	DR	DO	9.74	\$4.20
Paratransit, Inc.	DR	PT	10.46	\$7.07
Paratransit, Inc.	DT	PT	8.37	\$4.47
Peninsula Corridor Joint Powers Board dba: Caltrain	CR	PT	21.77	\$4.96
Peninsula Corridor Joint Powers Board dba: Caltrain	MB	PT	3.47	\$0.00
Placer County Department of Public Works and Facilities	CB	PT	20.11	\$5.37
Placer County Department of Public Works and Facilities	DR	DO	11.84	\$3.53
Placer County Department of Public Works and Facilities	DR	PT	3.41	\$0.73
Placer County Department of Public Works and Facilities	DT	PT	15.71	\$3.54
Placer County Department of Public Works and Facilities	MB	DO	7.64	\$1.05
Placer County Department of Public Works and Facilities	MB	PT	3.09	\$0.67
Placer County Department of Public Works and Facilities	VP	PT	33.94	\$2.79
Pomona Valley Transportation Authority	DR	PT	5.50	\$0.81
Pomona Valley Transportation Authority	DT	PT	4.81	\$1.94
Redding Area Bus Authority	DR	PT	8.86	\$3.26

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
Redding Area Bus Authority	MB	PT	6.99	\$1.02
Riverside Transit Agency	CB	DO	19.49	\$3.83
Riverside Transit Agency	CB	PT	23.22	\$2.08
Riverside Transit Agency	DR	PT	11.28	\$3.68
Riverside Transit Agency	DT	PT	17.51	\$4.05
Riverside Transit Agency	MB	DO	6.27	\$0.90
Riverside Transit Agency	MB	PT	6.64	\$1.33
Sacramento Regional Transit District	DR	DO	2.59	\$1.38
Sacramento Regional Transit District	LR	DO	6.01	\$1.29
Sacramento Regional Transit District	MB	DO	3.46	\$1.53
San Diego Association of Governments	VP	PT	48.70	\$3.11
San Diego Metropolitan Transit System	CB	PT	24.51	\$4.17
San Diego Metropolitan Transit System	DR	PT	10.38	\$4.52
San Diego Metropolitan Transit System	LR	DO	5.61	\$1.04
San Diego Metropolitan Transit System	MB	DO	4.51	\$1.02
San Diego Metropolitan Transit System	MB	PT	3.25	\$1.00
San Francisco Bay Area Rapid Transit District	HR	DO	13.72	\$3.64
San Francisco Bay Area Rapid Transit District	MG	PT	3.18	\$5.58
San Francisco Bay Area Water Emergency Transportation Authority	FB	PT	15.01	\$7.07
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
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 Regional Transit District	CB	PT	44.30	\$4.45
San Joaquin Regional Transit District	DT	PT	5.83	\$3.73
San Joaquin Regional Transit District	MB	DO	3.53	\$0.82
San Joaquin Regional Transit District	MB	PT	4.56	\$0.82
San Luis Obispo Regional Transit Authority	DR	DO	7.85	\$3.05
San Luis Obispo Regional Transit Authority	MB	DO	11.05	\$1.31
San Mateo County Transit District	DR	PT	8.10	\$2.51
San Mateo County Transit District	DT	PT	11.89	\$2.38
San Mateo County Transit District	MB	DO	3.61	\$1.32
San Mateo County Transit District	MB	PT	6.19	\$1.34
Santa Barbara Metropolitan Transit District	MB	DO	4.09	\$1.12



Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
Santa Clara Valley Transportation Authority	DR	PT	10.24	\$3.45
Santa Clara Valley Transportation Authority	DT	PT	10.68	\$2.86
Santa Clara Valley Transportation Authority	LR	DO	5.25	\$0.88
Santa Clara Valley Transportation Authority	MB	DO	5.18	\$0.88
Santa Clara Valley Transportation Authority	MB	PT	3.68	\$0.00
Santa Clarita Transit	CB	PT	24.78	\$3.03
Santa Clarita Transit	DR	PT	6.11	\$1.14
Santa Clarita Transit	MB	PT	4.23	\$0.84
Santa Cruz Metropolitan Transit District	CB	DO	31.21	\$5.42
Santa Cruz Metropolitan Transit District	DR	DO	7.24	\$4.08
Santa Cruz Metropolitan Transit District	DT	PT	7.23	\$2.09
Santa Cruz Metropolitan Transit District	MB	DO	4.27	\$1.52
Santa Maria Area Transit	DR	PT	7.40	\$0.44
Santa Maria Area Transit	MB	PT	3.73	\$1.02
Santa Monica's Big Blue Bus	DR	PT	2.27	\$0.41
Santa Monica's Big Blue Bus	MB	DO	3.81	\$0.89
Solano County Transit	CB	PT	13.78	\$2.50
Solano County Transit	DR	PT	5.36	\$2.21
Solano County Transit	MB	PT	2.64	\$2.43
Sonoma County Transit	DR	PT	12.17	\$3.77
Sonoma County Transit	MB	PT	8.33	\$1.49
Southern California Regional Rail Authority dba: Metrolink	CR	PT	29.15	\$5.79
SunLine Transit Agency	DR	DO	12.02	\$2.05
SunLine Transit Agency	MB	DO	6.86	\$0.65
The Eastern Contra Costa Transit Authority	DR	PT	6.00	\$3.08
The Eastern Contra Costa Transit Authority	MB	PT	7.23	\$1.11
Torrance Transit System	DT	PT	5.20	\$1.74
Torrance Transit System	MB	DO	4.95	\$0.66
Transit Joint Powers Authority for Merced County	DR	PT	6.36	\$3.69
Transit Joint Powers Authority for Merced County	MB	PT	6.22	\$1.57



Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
Unitrans - City of Davis/ASUCD	MB	DO	2.15	\$0.79
Ventura Intercity Service Transit Authority	CB	PT	20.34	\$1.60
Ventura Intercity Service Transit Authority	DR	PT	3.18	\$1.75
Ventura Intercity Service Transit Authority	MB	PT	4.37	\$0.85
Victor Valley Transit Authority	CB	PT	52.89	\$10.12
Victor Valley Transit Authority	DR	PT	13.17	\$2.96
Victor Valley Transit Authority	MB	PT	6.74	\$1.08
Victor Valley Transit Authority	VP	PT	48.72	\$4.17
Western Contra Costa Transit Authority	CB	PT	23.95	\$4.12
Western Contra Costa Transit Authority	DR	PT	8.15	\$1.35
Western Contra Costa Transit Authority	MB	PT	7.29	\$1.10
Yolo County Transportation District	DR	PT	12.25	\$4.88
Yolo County Transportation District	MB	PT	10.63	\$1.67
Yuba-Sutter Transit Authority	CB	PT	39.33	\$4.48
Yuba-Sutter Transit Authority	DR	PT	5.87	\$1.83
Yuba-Sutter Transit Authority	MB	PT	3.05	\$0.65

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

The following is a hypothetical project<sup>13</sup> 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:

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

<sup>13</sup> 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*<sub>Baseline</sub> + *Parking Cost*<sub>Baseline</sub>  
and,

*Travel Cost of New Mode* = *Transit Cost*<sub>New</sub>

**Step 1:** Calculate the Travel Cost of Baseline Mode

*Transportation Cost*<sub>Baseline</sub> = *Cost Per Mile*<sub>Baseline</sub> × *Miles*<sub>Baseline</sub>

$$\text{Transportation Cost}_{\text{Baseline}} = 0.58 \frac{\text{Dollars}}{\text{Mile}} \times 357,700 \frac{\text{Miles}}{\text{Year}} = \$207,466 \text{ per year}$$

*Parking Cost*<sub>Baseline</sub> = *Avoided Parking*<sub>Wd</sub> × *Parking Cost*<sub>Wd</sub> + *Avoided Parking*<sub>We</sub> × *Parking Cost*<sub>We</sub>

$$\begin{aligned} \text{Parking Cost}_{\text{Baseline}} &= \left( 20\% \times \frac{350 \frac{\text{Trip}}{\text{Day}}}{2} \times 5 \frac{\text{Days}}{\text{Week}} \times 52 \frac{\text{Weeks}}{\text{Year}} \right) \times \left( 11.13 \frac{\text{Dollars}}{\text{Trip}} \right) \\ &\quad + \left( 15\% \times \frac{350 \frac{\text{Trip}}{\text{Day}}}{2} \times 2 \frac{\text{Days}}{\text{Week}} \times 52 \frac{\text{Weeks}}{\text{Year}} \right) \\ &\quad \times \left( 1.50 \frac{\text{Dollars}}{\text{Hour}} \times 2 \frac{\text{Hours}}{\text{Trip}} \right) \\ &= 9,100 \frac{\text{Trips}}{\text{Year}} \times 11.13 \frac{\text{Dollars}}{\text{Trip}} + 2,730 \frac{\text{Trips}}{\text{Year}} \times 3 \frac{\text{Dollars}}{\text{Trip}} \\ &= \$109,473 \text{ per year} \end{aligned}$$

$$\begin{aligned} \text{Travel Cost of Baseline Mode} &= \$207,466 \text{ per year} + \$109,473 \text{ per year} \\ &= \$316,939 \text{ per year} \end{aligned}$$

**Step 2:** Calculate the Travel Cost of New Mode

*Transit Cost*<sub>New</sub> = *User Increase* × *Average Fare*

$$\begin{aligned} \text{Transit Cost}_{\text{New}} &= \left( 350 \frac{\text{Trips}}{\text{Day}} \times 365 \frac{\text{Days}}{\text{Year}} \right) \times 1.30 \frac{\text{Dollars}}{\text{Trip}} \\ &= 127,750 \frac{\text{Trips}}{\text{Year}} \times 1.30 \frac{\text{Dollars}}{\text{Trip}} = \$113,762 \text{ per year} \end{aligned}$$

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

**Step 3:** Calculate the Travel Cost Savings

$$\begin{aligned} \text{Travel Cost Savings} &= (\$316,939 \text{ per year} - \$166,075 \text{ per year}) \\ &\quad \times 0.685 \text{ Adjustment Factor} \times 1 \text{ year} \\ &= \$103,342 \end{aligned}$$

In this example, it is estimated that the project would result in travel cost savings for transit riders of \$103,342 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<sup>14</sup> 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:

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

<sup>14</sup> 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:

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

Where:

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

and,

$$\text{Travel Cost of New Mode} = \text{Transit Cost}_{\text{New}}$$

**Step 1: Calculate the Travel Cost of Baseline Mode**

$$\text{Transportation Cost}_{\text{Baseline}} = \text{Cost Per Mile}_{\text{Baseline}} \times \text{Miles}_{\text{Baseline}}$$

$$\text{Transportation Cost}_{\text{Baseline}} = 0.58 \frac{\text{Dollars}}{\text{Mile}} \times 128,300 \frac{\text{Miles}}{\text{Year}} = \$74,414 \text{ per year}$$

$$\text{Parking Cost}_{\text{Baseline}} = \text{Avoided Parking}_{\text{Wd}} \times \text{Parking Cost}_{\text{Wd}} + \text{Avoided Parking}_{\text{We}} \times \text{Parking Cost}_{\text{We}}$$

$$\begin{aligned} \text{Parking Cost}_{\text{Baseline}} &= \left( 30\% \times \frac{116 \frac{\text{Trip}}{\text{Day}}}{2} \times 5 \frac{\text{Days}}{\text{Week}} \times 52 \frac{\text{Weeks}}{\text{Year}} \right) \times \left( 11.13 \frac{\text{Dollars}}{\text{Trip}} \right) \\ &\quad + \left( 20\% \times \frac{116 \frac{\text{Trip}}{\text{Day}}}{2} \times 2 \frac{\text{Days}}{\text{Week}} \times 52 \frac{\text{Weeks}}{\text{Year}} \right) \times \left( 1.50 \frac{\text{Dollars}}{\text{Hour}} \times 2 \frac{\text{Hours}}{\text{Trip}} \right) \\ &= 4,524 \frac{\text{Trips}}{\text{Year}} \times 11.13 \frac{\text{Dollars}}{\text{Trip}} + 1,206 \frac{\text{Trips}}{\text{Year}} \times 3 \frac{\text{Dollars}}{\text{Trip}} \\ &= \$53,970 \text{ per year} \end{aligned}$$

$$\begin{aligned} \text{Travel Cost of Baseline Mode} &= \$74,414 \text{ per year} + \$53,970 \text{ per year} \\ &= \$128,384 \text{ per year} \end{aligned}$$

**Step 2: Calculate the Travel Cost of New Mode**

$$\text{Transit Cost}_{\text{New}} = \text{User Increase} \times \text{Average Fare}$$

$$\begin{aligned} \text{Transit Cost}_{\text{New}} &= \left( 116 \frac{\text{Trips}}{\text{Day}} \times 365 \frac{\text{Days}}{\text{Year}} \right) \times 0.75 \frac{\text{Dollars}}{\text{Trip}} \\ &= 42,340 \frac{\text{Trips}}{\text{Year}} \times 0.75 \frac{\text{Dollars}}{\text{Trip}} = \$31,755 \text{ per year} \end{aligned}$$

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

**Step 3:** Calculate the Travel Cost Savings from Mode Shift

$$\begin{aligned}
 \text{Travel Cost Savings}_{\text{Mode Shift}} &= (\$128,384 \text{ per year} - \$31,755 \text{ per year}) \\
 &\quad \times 0.561 \text{ Adjustment Factor} \times 2 \text{ years} \\
 &= \$108,418
 \end{aligned}$$

**Step 4:** Calculate the Travel Cost Savings from Fare Reduction

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

**Step 5:** Calculate the Travel Cost Savings from Travel Subsidy

$$\begin{aligned}
 \text{Travel Cost Savings}_{\text{Travel Subsidy}} &= \text{Travel Cost Savings}_{\text{Mode Shift}} \\
 &\quad + \text{Travel Cost Savings}_{\text{Fare Reduction}} \\
 &\quad \times (1 - \text{Adjustment Factor}) \times \text{Quantification Period} \\
 &= \$108,418 + \$52,925 \text{ per year} \\
 &\quad \times (1 - 0.561 \text{ Adjustment Factor}) \times 2 \text{ years} \\
 &= \$108,418 + \$46,468 \\
 &= \$154,886
 \end{aligned}$$

In this example, it is estimated that the project would result in travel cost savings for transit riders of \$154,886 during the two-year project quantification period.

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

The following is a hypothetical project<sup>15</sup> 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:

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

Where:

$$\text{Travel Cost of Baseline Mode} = \text{Transportation Cost}_{\text{Baseline}}$$

and,

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

### Step 1: Calculate the Travel Cost of Baseline Mode

$$\begin{aligned} \text{Transportation Cost}_{\text{Baseline}} &= \text{Cost Per Mile}_{\text{Baseline}} \times \text{Miles}_{\text{Baseline}} \\ &= 0.58 \frac{\text{Dollars}}{\text{Mile}} \times 15,120 \frac{\text{Miles}}{\text{Year}} = \$8,769.60 \text{ per year} \end{aligned}$$

<sup>15</sup> 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

$$\begin{aligned} \text{Active Transportation Cost}_{New} &= \text{Cost Per Mile}_{Active} \times \text{Miles}_{Active} \\ &= 0.04 \frac{\text{Dollars}}{\text{Mile}} \times 15,120 \frac{\text{Miles}}{\text{Year}} = \$604.80 \text{ per year} \end{aligned}$$

**Step 3:** Calculate the Travel Cost Savings

$$\begin{aligned} \text{Travel Cost Savings} &= (\$8,769.60 \text{ per year} - \$604.80 \text{ per year}) \times 15 \text{ years} \\ &= \$122,472 \end{aligned}$$

In this example, it is estimated that the project would result in travel cost savings for active transportation users of \$122,472 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 Resources. (2019). Mileage Reimbursement Rates. Available at: <https://www.calhr.ca.gov/employees/Pages/travel-reimbursements.aspx>.

U.S. Department of Transportation. Consumer Airfare Report, Table 1: Top 1,000 Contiguous State City-Pair Markets. This data is from the 1<sup>st</sup> to 4<sup>th</sup> quarter of 2018. Available at: <https://data.transportation.gov/Aviation/Consumer-Airfare-Report-Table-1-Top-1-000-Contiguo/4f3n-jbg2>.