

California Air Resources Board

Quantification Methodology

California Air Resources Board
Sustainable Transportation Equity Project

California Climate Investments



June 1, 2020

Table of Contents

Section A. Introduction	1
Methodology Development	2
Tools.....	3
Section B. Methods.....	4
Strategies and Project Types	4
General Approach.....	4
A. Emission Reductions from Active Transportation.....	6
B. Emission Reductions from Fixed-route Transit	9
C. Emission Reductions from Shared Mobility	13
Section C. References	17
Appendix A. Suggested Value Lookup Tables for Public Transit	18
Table 1. Strategies	4
Table 2. Active Transportation Adjustment Factors	6
Table 3. Key Destination Credits	7

List of Acronyms and Abbreviations

Acronym	Term
CARB	California Air Resources Board
Diesel PM	diesel particulate matter
GGE	gasoline gallon equivalent
GGRF	Greenhouse Gas Reduction Fund
GHG	greenhouse gas
lbs	pounds
MTCO ₂ e	metric tons of carbon dioxide equivalent
NO _x	nitrous oxide
PM _{2.5}	particulate matter with a diameter less than 2.5 micrometers
ROG	reactive organic gas
STEP	Sustainable Transportation Equity Project
VMT	vehicle miles traveled

List of Definitions

Term	Definition
Co-benefit	A social, economic, or environmental benefit as a result of the proposed project in addition to the GHG emission reduction benefit.
Community engagement level	Evaluation of the quantity, quality, and equity of the community engagement conducted. Options are Low, Medium, and High.
Key variable	Project characteristics that contribute to a project’s GHG emission reductions and signal an additional benefit (e.g., passenger VMT reductions, renewable energy generated).
Net fossil fuel use reduction	Net changes in the quantity of fossil fuels used in terms of gasoline gallon equivalent due to conversion to an alternative energy or fuel source as a result of the project.
Net passenger auto VMT reduction	Passenger auto vehicle miles traveled displaced by new mobility service due to mode shift as a result of the project minus vehicle miles traveled in passenger autos from the new mobility service.
Quantification period	Number of years that the project component will provide GHG emission reductions. Sometimes also referred to as "Useful Life" or "Project Implementation Time Frame."
Strategy	Categories of projects that Applicants may employ in order to achieve their vision. For the purposes of the STEP Quantification Methodology, projects that are eligible for funding within STEP and for which there are methods to quantify GHG emission reductions fall into one of three strategies. Each strategy may be funded through specific project types.
Travel cost savings	Changes in travel costs to the user due to mode shift as a result of the project.

Section A. Introduction

California Climate Investments is a statewide initiative that puts billions of Cap-and-Trade dollars to work facilitating greenhouse gas (GHG) emission reductions; strengthening the economy; improving public health and the environment; and providing benefits to residents of disadvantaged communities, low-income communities, and low-income households, collectively referred to as “priority populations.” Where applicable and to the extent feasible, California Climate Investments must maximize economic, environmental, and public health co-benefits to the State.

The California Air Resources Board (CARB) is responsible for providing guidance on estimating the GHG emission reductions and co-benefits from projects receiving monies from the Greenhouse Gas Reduction Fund (GGRF). This guidance includes quantification methodologies, co-benefit assessment methodologies, and benefits calculator. CARB develops these methodologies and tools based on the project types eligible for funding by each administering agency, as reflected in the program expenditure records available at: www.arb.ca.gov/cci-expenditurerecords.

For the CARB Sustainable Transportation Equity Project (STEP), CARB staff developed this Quantification Methodology to provide guidance for estimating the GHG emission reductions and selected co-benefits of each proposed project type. This methodology uses calculations to estimate GHG emission reductions from clean transportation projects.

The STEP Benefits Calculator automates methods described in this document, provides a link to a step-by-step user guide with a project example, and outlines documentation requirements. Projects will report the total project GHG emission reductions and co-benefits estimated using the STEP Benefits Calculator as well as the total project GHG emission reductions per dollar of GGRF funds requested. The STEP Benefits Calculator is available for download at: <http://www.arb.ca.gov/cci-resources>.

Using many of the same inputs required to estimate GHG emission reductions, the STEP Benefits Calculator estimates the following co-benefits and key variables from STEP projects:

- Diesel PM emission reductions (lbs)
- NO_x emission reductions (lbs)
- PM_{2.5} emission reductions (lbs)
- ROG emission reductions (lbs)
- Net passenger auto VMT reductions (miles)
- Travel cost savings (\$)
- Net fossil fuel use reductions (GGE)
- Community engagement level (low, medium, or high)
- Jobs supported

Key variables are project characteristics that contribute to a project's GHG emission reductions and signal an additional benefit (e.g., VMT reduction). Additional co-benefits for which CARB assessment methodologies were not incorporated into the STEP Benefits Calculator may also be applicable to the project. Applicants should consult the STEP Solicitation and other program materials to ensure they are meeting STEP requirements. All CARB co-benefit assessment methodologies are available at: www.arb.ca.gov/cci-cobenefits.

Methodology Development

CARB developed this Quantification Methodology consistent with the guiding principles of California Climate Investments, including ensuring transparency and accountability.¹ CARB developed this Quantification Methodology to be used to estimate the outcomes of proposed projects, confirm that projects meet minimum program requirements, and track results of funded projects. The implementing principles ensure that the methodology would:

- Apply at the project-level;
- Provide uniform methods to be applied statewide, and be accessible by all applicants and users;
- Use existing and proven methods;
- Use project-level data, where available and appropriate; and
- Result in GHG emission reduction estimates that are conservative and supported by empirical literature.

CARB assessed peer-reviewed literature and tools and consulted with experts, as needed, to determine methods appropriate for the STEP project types. CARB also consulted with program staff to determine project-level inputs available. The methods were developed to provide estimates that are as accurate as possible with data readily available at the project level.

In addition, the University of California, Berkeley, in collaboration with CARB, developed assessment methodologies for a variety of co-benefits such as providing cost savings, lessening the impacts and effects of climate change, and strengthening community engagement. Co-benefit assessment methodologies are posted at: www.arb.ca.gov/cci-cobenefits.

¹ California Air Resources Board. www.arb.ca.gov/cci-fundingguidelines

Tools

The STEP Benefits Calculator relies on CARB-developed emission factors. CARB has established a single repository for emission factors used in CARB's benefits calculators, referred to as the California Climate Investments Quantification Methodology Emission Factor Database (Database), available at: <http://www.arb.ca.gov/cci-resources>. The Database Documentation explains how emission factors used in CARB benefits calculators are developed and updated.

STEP Implementation Grant Applicants must use the STEP Benefits Calculator to estimate the GHG emission reductions and co-benefits of each quantifiable proposed project. The STEP Benefits Calculator can be downloaded from: <http://www.arb.ca.gov/cci-resources>.

Section B. Methods

The following section provides details on the methods supporting emission reductions in the STEP Benefits Calculator.

Strategies and Project Types

CARB identified three **Strategies** that are eligible for funding within STEP for which there are methods to quantify GHG emission reductions, defined in the table below.

Table 1. Strategies

Strategy	Definition
Active Transportation	Includes projects such as bicycle, pedestrian, and complete streets infrastructure (e.g., crosswalks, sidewalks, bikeways).
Fixed-route Transit	Includes projects such as transit station improvements, transit right-of-way improvements (e.g., bus rapid transit lanes), transit operations improvements, transit passes, and improvements to increase accessibility of transit (e.g., network/fare integration, wayfinding, and signage).
Shared Mobility	Includes projects such as zero-emission carshare, rideshare, vanpooling, carpooling, bikeshare, scooter share, ride-hailing, shuttles, and microtransit (on-demand transit) services. Shared mobility projects should be complementary to existing public transit service. Shared mobility projects could include new service, operations, or promotion of ridership or pooling through subsidies.

Other project features/components may be eligible for funding under STEP even if no quantification methodology is provided here. However, each project requesting GGRF funding must include at least one of the strategies in the table above. See the STEP Implementation Grant Solicitation for more information on project eligibility.

General Approach

Methods used in the STEP Benefits Calculator for estimating the GHG emission reductions and air pollutant emission co-benefits by project type are provided in this section. The Database Documentation explains how emission factors used in CARB benefits calculators are developed and updated.

In general, the GHG emission reductions are estimated in the STEP Benefits Calculator using the following approaches:

- **Active Transportation:** Emission Reductions from Displaced Autos
- **Fixed-route Transit:** Emission Reductions from Displaced Autos
 - If the project is a new/expanded service, emissions from the new service are subtracted from the emission reductions from displaced autos

- **Shared Mobility:** Emission Reductions from Displaced Autos – Emissions from New Service

The STEP Benefits Calculator also estimates air pollutant emission co-benefits and key variables using many of the same inputs used to estimate GHG emission reductions.

A. Emission Reductions from Active Transportation

Equation 1 calculates the annual auto VMT displaced by the project. Projects that maintain the same bikeway class that already exists are not quantifiable. See references in Section C for more information on default values used.

Equation 11: Annual Auto VMT Reduced in Miles per Year

$AutoVMT_{Displaced_Yr} = D \times ADT \times (A + C) \times GFA \times L$		
<p>Where,</p>		
		<u>Units</u>
$AutoVMT_{Displaced_Yr}$	= Annual auto VMT displaced in the first or final year	miles/year
D	= Annual days of use of new facility. Default is 200 days.	days/year
ADT	= Average two-way daily traffic on road parallel to facility.	vehicle trips/day
A	= Adjustment factor for active transportation (see the table below).	mile(s)/trip
C	= Credit for key destinations near facility (see the table below).	unitless
GFA	= Growth factor adjustment. Default is 1 for pedestrian infrastructure and new Class II bike lanes, 1.54 for new Class I bike paths or Class IV cycle tracks, and 0.54 for conversion from Class II bike lanes to Class IV cycle tracks.	unitless
L	= Average length of auto trip replaced. Default is 0.3 miles for pedestrian trips and 1.5 miles for bike trips.	miles

Table 2. Active Transportation Adjustment Factors

Average Daily Traffic (vehicle trips per day)	One-way Facility Length ² (miles)	Adjustment Factor for Population > 250,000 or Non-university Town with Population < 250,000	Adjustment Factor for University Town with Population < 250,000
1 to 12,000	≤ 1	0.0019	0.0104
1 to 12,000	1.01 to 2	0.0029	0.0155
1 to 12,000	> 2	0.0038	0.0207
12,001 to 24,000	≤ 1	0.0014	0.0073
12,001 to 24,000	1.01 to 2	0.0020	0.0109

² The length of bicycle facilities should be measured in one direction because the adjustment factor, based on length and ADT, accounts for two-way trips.

Average Daily Traffic (vehicle trips per day)	One-way Facility Length ² (miles)	Adjustment Factor for Population > 250,000 or Non-university Town with Population < 250,000	Adjustment Factor for University Town with Population < 250,000
12,001 to 24,000	> 2	0.0027	0.0145
24,001 to 30,000	≤ 1	0.0010	0.0052
24,001 to 30,000	1.01 to 2	0.0014	0.0078
24,001 to 30,000	> 2	0.0019	0.0104

Table 3. Key Destination Credits

Number of Key Destinations	Credit Within ½ Mile of Facility	Credit Within ¼ Mile of Facility
0 to 2	0	0
3	0.0005	0.001
4 to 6	0.0010	0.002
≥ 7	0.0015	0.003

Equation 2 calculates the annual emission reductions associated with auto VMT displaced by the project.

Equation 2: Annual Emission Reductions from Displaced Auto VMT

$$E_{Reduced_Yr} = \frac{AutoVMT_{Displaced_Yr} \times EF_{Yr}}{CF}$$

Where,

		Units
$E_{Reduced_Yr}$	= Annual emission reductions from displaced auto VMT	MTCO ₂ e/year or lbs/year
$AutoVMT_{Displaced_Yr}$	= Estimated VMT displaced in the first or final year attributed to the project	miles/year
EF_{Yr}	= Emission factor in the first or final year (based on weighted fleet average)	grams/mile
CF	= Conversion factor	grams/MT or grams/lb

Equation 3 estimates both the GHG and air pollutant emission reductions from Active Transportation projects as the emission reductions from displaced auto VMT. See references in Section C for more information on default values used.

Equation 3: Emission Reductions from Displaced Auto VMT

$$E_{Reduced} = \frac{E_{Reduced_Yr1} + E_{Reduced_YrF}}{2} \times QP$$

Where,

		<u>Units</u>
$E_{Reduced}$	= Total emission reductions from displaced auto VMT	MTCO ₂ e or lbs
$E_{Reduced_Yr1}$	= Emission reductions from displaced auto VMT in first year	MTCO ₂ e/year or lbs/year
$E_{Reduced_YrF}$	= Emission reductions from displaced auto VMT in final year	MTCO ₂ e/year or lbs/year
QP	= Quantification period. Default is 20 years for pedestrian infrastructure and Class I bike paths and 15 years for Class II bike lanes and Class IV cycle tracks.	years

B. Emission Reductions from Fixed-route Transit

Equation 4 calculates the annual auto VMT displaced by the project. See references in Section C for more information on default values used.

Equation 42: Annual Auto VMT Displaced in Miles per Year

$$AutoVMT_{Displaced_Yr} = R_{Yr} \times A \times L_P$$

<i>Where,</i>		<u>Units</u>
$AutoVMT_{Displaced_Yr}$	= Annual auto VMT displaced in the first or final year	miles/year
R_{Yr}	= Number of riders per vehicle in the first or final year	rider(s)/vehicle
A	= Adjustment factor to account for transit dependency. Defaults are 0.5 for local passenger trips and 0.83 for long-distance passenger trips.	unitless
L_P	= Estimated length of average passenger trip directly associated with the project (see Appendix A for suggested values).	mile(s)/trip

Equation 5 calculates the annual emission reductions associated with auto VMT displaced by the project.

Equation 5: Annual Emission Reductions from Displaced Auto VMT

$$E_{Reduced_Yr} = \frac{AutoVMT_{Displaced_Yr} \times EF_{Yr}}{CF}$$

<i>Where,</i>		<u>Units</u>
$E_{Reduced_Yr}$	= Annual emission reductions from displaced auto VMT	MTCO ₂ e/year or lbs/year
$AutoVMT_{Displaced_Yr}$	= Estimated VMT displaced in the first or final year attributed to the operation of the new service	miles/year
EF_{Yr}	= Emission factor in the first or final year (based on weighted fleet average)	grams/mile
CF	= Conversion factor	grams/MT or grams/lb

Equation 6 estimates both the GHG and air pollutant emission reductions from Fixed-route Transit projects as the emission reductions from displaced auto VMT.

Equation 6: Emission Reductions from Displaced Auto VMT

$$E_{Reduced} = \frac{E_{Reduced_Yr1} + E_{Reduced_YrF}}{2} \times QP$$

Where,		Units
$E_{Reduced}$	= Total emission reductions from displaced auto VMT	MTCO ₂ e or lbs
$E_{Reduced_Yr1}$	= Emission reductions from displaced auto VMT in first year	MTCO ₂ e/year or lbs/year
$E_{Reduced_YrF}$	= Emission reductions from displaced auto VMT in final year	MTCO ₂ e/year or lbs/year
QP	= Quantification period	years

If the project is a new/expanded service, the method continues below. If not, the emission reductions from displaced auto VMT ($E_{Reduced}$) calculated in the equation above are the total emission reductions.

Equation 7 calculates the annual vehicle miles traveled associated with operation of the new service.

Equation 7: Annual VMT from New Service

$$NSVMT = \frac{(V_1 \times VMT_{V_1}) + (V_F \times VMT_{V_F})}{2}$$

Where,		Units
$NSVMT$	= Estimated average annual VMT attributed to the operation of the new service	miles/year
V_{Yr}	= Number of vehicles directly associated with the project in first or final year	vehicles
VMT_{V_Yr}	= Estimated vehicle miles traveled per vehicle expected in first or final year directly associated with the project	trips/vehicle

Equation 8 calculates the annual emissions associated with operation of the new service.

Equation 8: Annual Emissions from New Service

$AE_{New} = \frac{NSVMT \times NSEF \times \%RE}{CF}$		
<i>Where,</i>		
AE_{New}	= Average annual emissions from new service	<u>Units</u> MTCO ₂ e/year or lbs/year
$NSVMT$	= Estimated average annual VMT attributed to the operation of the new service	miles
$NSEF_{yr}$	= Mid-year emission factor based on service type	grams/mile
$\%RE$	= Sum of percent installed and purchased renewable electricity used for new vehicle charging, if applicable	unitless
CF	= Conversion factor	grams/MT or grams/lb

Equation 9 calculates the total emissions associated with operation of the new service.

Equation 9: Emissions from New Service

$E_{New} = AE_{New} \times QP$		
<i>Where,</i>		
E_{New}	= Total emissions from new service	<u>Units</u> MTCO ₂ e or lbs
AE_{New}	= Average annual emissions from new service	MTCO ₂ e/year or lbs/year
QP	= Quantification period	years

Equation 10 estimates the GHG and air pollutant emission reductions from Fixed-route Transit projects, calculated as the difference between the emission reductions from displaced autos and emissions associated with operation of the new service.

Equation 10: Net Emission Reductions from New Service

$$E = E_{Reduced} - E_{New}$$

Where,

		<u>Units</u>
E	= Net emission reductions	MTCO ₂ e or lbs
$E_{Reduced}$	= Total emission reductions from displaced auto VMT	MTCO ₂ e or lbs
E_{New}	= Total emissions from new service	MTCO ₂ e or lbs

C. Emission Reductions from Shared Mobility

Equation 11 calculates the annual auto VMT displaced by the new service. See references in Section C for more information on default values used.

Equation 11: Annual Auto VMT Displaced

$$AutoVMT_{Displaced_Yr} = R_{Yr} \times V_{Yr} \times T_{Yr} \times A \times L$$

Where,

		<u>Units</u>
$AutoVMT_{Displaced_Yr}$	= Annual auto VMT displaced in the first or final year	miles/year
R_{Yr}	= Average occupancy per vehicle in the first or final year. Defaults are 1 for standard bicycle, electric bicycle, electric moped, and electric scooter. Suggested value for ride-hailing services is 1.55.	rider(s)/vehicle
V_{Yr}	= Number of vehicles directly associated with the project in the first or final year	vehicles
T_{Yr}	= Average number of annual vehicle trips per vehicle expected directly associated with the project in the first or final year	trips/vehicle
A	= Adjustment factor to account for transit dependency and induced trips. Defaults are 0.5 for local passenger trips and 0.83 for long-distance passenger trips. An additional adjustment of 0.6 is applied for ride-hailing services to account for deadhead miles.	unitless
L	= Estimated length of average vehicle trip directly associated with the project (should include deadhead miles for ride-hailing service)	mile(s)/trip

Equation 12 calculates the annual emission reductions associated with auto VMT displaced by the new service.

Equation 12: Annual Emission Reductions from Displaced Auto VMT

$E_{Reduced_Yr} = \frac{AutoVMT_{Displaced_Yr} \times EF_{Yr}}{CF}$		
<i>Where,</i>		
$E_{Reduced_Yr}$	= Annual emission reductions from displaced auto VMT	<u>Units</u> MTCO ₂ e/year or lbs/year
$AutoVMT_{Displaced_Yr}$	= Estimated VMT displaced in the first or final year attributed to the operation of the new service	miles/year
EF_{Yr}	= Emission factor in the first or final year (based on weighted fleet average)	grams/mile
CF	= Conversion factor	grams/MT or grams/lb

Equation 13 calculates the total emission reductions associated with auto VMT displaced by the new service.

Equation 13: Emission Reductions from Displaced Auto VMT

$E_{Reduced} = \frac{E_{Reduced_Yr1} + E_{Reduced_YrF}}{2} \times QP$		
<i>Where,</i>		
$E_{Reduced}$	= Total emission reductions from displaced auto VMT	<u>Units</u> MTCO ₂ e or lbs
$E_{Reduced_Yr1}$	= Emission reductions from displaced auto VMT in first year	MTCO ₂ e/year or lbs/year
$E_{Reduced_YrF}$	= Emission reductions from displaced auto VMT in final year	MTCO ₂ e/year or lbs/year
QP	= Quantification period	years

Equation 14 calculates the annual VMT from the new service.

Equation 14: Annual VMT of New Service

$NSVMT = \frac{(V_1 \times T_1 \times L_{V_1}) + (V_F \times T_F \times L_{V_F})}{2}$		
<i>Where,</i>		
		<u>Units</u>
$NSVMT$	= Estimated average annual VMT attributed to the operation of the new service	miles/year
V_{Yr}	= Number of vehicles directly associated with the project in first or final year	vehicles
T_{Yr}	= Number of annual trips per vehicle expected in first or final year directly associated with the project	trips/vehicle
$L_{V_{Yr}}$	= Estimated length of average vehicle trip directly associated with the project	mile(s)/trip

Equation 15 calculates the annual emissions associated with operation of the new service.

Equation 15: Annual Emissions from New Service

$AE_{New} = \frac{NSVMT \times NSEF \times \%RE}{CF}$		
<i>Where,</i>		
		<u>Units</u>
AE_{New}	= Average annual emissions from new service	MTCO ₂ e/year or lbs/year
$NSVMT$	= Estimated average annual VMT attributed to the operation of the new service	miles
$NSEF_{Yr}$	= Mid-year emission factor based on service type	grams/mile
$\%RE$	= Sum of percent installed and purchased renewable electricity used for new vehicle charging, if applicable	unitless
CF	= Conversion factor	grams/MT or grams/lb

Equation 16 calculates the total emissions associated with operation of the new service.

Equation 16: Emissions from New Service

$$E_{New} = AE_{New} \times QP$$

<i>Where,</i>		<u>Units</u>
E_{New}	= Total emissions from new service	MTCO ₂ e or lbs
AE_{New}	= Average annual emissions from new service	MTCO ₂ e/year or lbs/year
QP	= Quantification period	years

Equation 17 estimates the GHG and air pollutant emission reductions from Shared Mobility projects, calculated as the difference between the emission reductions from displaced autos and emissions associated with operation of the new service.

Equation 17: Net Emission Reductions from New Service

$$E = E_{Reduced} - E_{New}$$

<i>Where,</i>		<u>Units</u>
E	= Net emission reductions	MTCO ₂ e or lbs
$E_{Reduced}$	= Total emission reductions from displaced auto VMT	MTCO ₂ e or lbs
E_{New}	= Total emissions from new service	MTCO ₂ e or lbs

Section C. References

The following references were used in the development of this Quantification Methodology and the STEP Benefits Calculator.

California Air Resources Board. (2019). Clean Miles Standard 2018 Base-year Emissions Inventory Report. <http://www.arb.ca.gov/our-work/programs/clean-miles-standard/resources>

California Air Resources Board. (2020). California Climate Investments Quantification Methodology Emission Factor Database. <http://www.arb.ca.gov/cci-resources>

California Air Resources Board, California Department of Transportation. (2005). Methods to Find the Cost-Effectiveness of Funding Air Quality Projects for Evaluating Motor Vehicle Registration Fee Projects and Congestion Mitigation and Air Quality Improvement Projects. <http://www.arb.ca.gov/planning/tsaq/eval/eval.htm>

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University of California, Davis. (2020). Technical Report: Revisiting Average Trip Length Defaults and Adjustment Factors for Quantifying VMT Reductions from Car Share, Bike Share, and Scooter Share Services. https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/sharedmobility_technical_052920.pdf?_ga=2.25215229.1303861497.1590691491-1100430164.1588262084

University of California, Davis. (2019). Technical Report: Updated Default Values for Transit Dependency and Average Length of Unlinked Transit Passenger Trips, for Calculations Using TAC Methods for California Climate Investments Programs. http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/transit_factors_technical_081319.pdf

Appendix A. Suggested Value Lookup Tables for Public Transit

List of Acronyms and Abbreviations

Acronym	Term
CB	commuter bus
CC	cable car
CR	commuter rail
DO	directly operated
DR	demand response
DT	demand response taxi
FB	ferryboat
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
VP	vanpool
YR	hybrid rail

CARB staff developed these suggested values to use for the length of the average unlinked passenger trip and baseline average fare cost by agency, by mode, and by type of service using 2017 Annual data from the National Transit Database.³ These values were calculated by dividing passenger miles traveled by unlinked passenger trips.

Table A-1. 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

³ Federal Transit Administration. National Transit Database. Available at <https://www.transit.dot.gov/ntd>.

Quantification Methodology for the CARB STEP Pilot

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
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
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

Quantification Methodology for the CARB STEP Pilot

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
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
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

Quantification Methodology for the CARB STEP Pilot

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
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
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

Quantification Methodology for the CARB STEP Pilot

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
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
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

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
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
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

Quantification Methodology for the CARB STEP Pilot

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
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
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

Agency	Mode	Type of Service	Length of Average Trip	Average Fare Cost per Trip
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