

**California Air Resources Board**

# **Quantification Methodology**

**California Department of Transportation  
Low Carbon Transit Operations Program**

**California Climate Investments**



**FINAL  
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## List of Acronyms and Abbreviations

Acronym	Term
CARB	California Air Resources Board
Caltrans	California Department of Transportation
CB	commuter bus
CC	cable car
CMAQ	Congestion Mitigation and Air Quality
CR	commuter rail
Diesel PM	diesel particulate matter
DMU	diesel multiple unit
DO	directly operated
DR	demand response
DT	demand response taxi
EMU	electric multiple unit
FB	ferryboat
GGRF	Greenhouse Gas Reduction Fund
GHG	greenhouse gas
hp	horsepower
HR	heavy rail
kWh	kilowatt hours
lbs	pounds
LCTOP	Low Carbon Transit Operations Program
LR	light rail
MB	bus
MG	monorail/automated guideway
MJ	megajoule
MTCO <sub>2e</sub>	metric tons of carbon dioxide equivalent
NO <sub>x</sub>	nitrous oxide
PM	particulate matter
PM <sub>2.5</sub>	particulate matter with a diameter less than 2.5 micrometers
PM <sub>10</sub>	particulate matter with a diameter less than 10 micrometers
PT	purchased transportation
RB	bus rapid transit
ROG	reactive organic gas
SR	streetcar rail
TAC	transit and connectivity
TB	trolley bus
VMT	vehicle miles traveled
VP	vanpool
YR	hybrid rail

## List of Definitions

Term	Definition
Adjustment Factor	Discount factor applied to annual ridership to account for transit-dependent riders.
Baseline Vehicle	The vehicle that is currently owned/in operation that will be replaced by a new zero- or near zero-emission vehicle purchase, or the vehicle that would have been purchased if not for this project (e.g., 2022 diesel bus).
CMAQ Methods	The 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.
Co-benefit	A social, economic, or environmental benefit as a result of the proposed project in addition to the GHG reduction benefit.
Directly Operated	Transportation service provided directly by a transit agency, using their employees to supply the necessary labor to operate the revenue vehicles. This includes instances where an agency's employees provide purchased transportation (PT) services to the agency through a contractual agreement.
Energy and Fuel Cost Savings	Changes in energy and fuel costs to the transit operator as a result of the project. Savings may be achieved by changing the quantity of energy or fuel used, conversion to an alternative energy or fuel source/vehicle, or renewable energy or fuel generation to displace existing fuel purchases.
Fuel/Energy Reduction	Quantification method that identifies projects that result in using less fuel or energy from existing transit services, or producing renewable energy/fuel. This includes projects that reduce transit VMT and idling, or generate renewable electricity. For example, optimizing bus routes to reduce diesel fuel usage or installing solar panels to displace grid electricity is a project that would use the "fuel/energy reduction" quantification method.
Increased Ridership	Quantification method that identifies projects that result in increased ridership for existing routes. This may include projects that increase service levels, reliability, safety, or decrease travel times. For example, implementing integrated ticketing and improving scheduling systems is a project that would use the "increased ridership" quantification method.

Term	Definition
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).
New Service	Quantification method that identifies projects that result in a new transportation service. This may include expansion of an existing service. For example, constructing a new rail line or adding new buses to an existing transit route is a project that would use the "new service" quantification method.
Project Type	For the purposes of the LCTOP Quantification Methodology, eligible projects fall into fifteen project types that meet the objectives program and for which there are methods to quantify GHG emission reductions.
Purchased Transportation	Transportation service provided to a public transit agency or governmental unit from a public or private transportation provider based on a written contract. The provider is obligated in advance to operate public transportation services for a public transit agency or governmental unit for a specific monetary consideration, using its own employees to operate revenue vehicles.
Quantification Period	Number of years that the project will provide GHG emission reductions that can reasonably be achieved and assured. Sometimes referred to as "Project Life" or "Useful Life".
Replacement	Identifies projects that replace a baseline vehicle(s) with a new vehicle(s) without resulting in new service.
Technology Conversion	Quantification method that identifies projects that result in the use of cleaner vehicles, technologies, or fuels. For example, replacing existing diesel buses with electric buses or using renewable natural gas instead of fossil natural gas is a project that would use the "technology conversion" quantification method.
Travel Cost Savings	Changes in travel costs to the user as a result switching travel modes.
Unlinked Passenger Trips	Number of passengers who board public transportation vehicles.

## Section A. Introduction

California Climate Investments is a statewide initiative that puts billions of Cap-and-Trade dollars to work facilitating 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.

CARB is responsible for providing guidance on estimating the GHG emission reductions and co-benefits from projects receiving monies from the GGRF. This guidance includes quantification methodologies, co-benefit assessment methodologies, benefits calculator tools, and associated user guides. 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](http://www.arb.ca.gov/cci-expenditurerecords).

For the Caltrans LCTOP, CARB staff developed this LCTOP Quantification Methodology and accompanying LCTOP Benefits Calculator Tool 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 and avoided GHG emissions from transit operation and capital projects.

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

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

- Local ROG emission reductions (lbs),
- Local NO<sub>x</sub> emission reductions (lbs),
- Local PM<sub>2.5</sub> emission reductions (lbs),
- Local Diesel PM emission reductions (lbs),
- Remote ROG emission reductions (lbs),
- Remote NO<sub>x</sub> emission reductions (lbs),
- Remote PM<sub>2.5</sub> emission reductions (lbs),
- Remote Diesel PM emission reductions (lbs),
- Passenger VMT reductions (miles),
- Fossil fuel use reductions (gallons),

- Renewable energy generated (kWh),
- Fossil fuel energy use reductions (kWh),
- Passenger travel cost savings (\$), and
- Energy and fuel cost savings (\$).

Additional co-benefits for which CARB assessment methodologies were not incorporated into the LCTOP Benefits Calculator Tool may also be applicable to the project. Applicants should consult the LCTOP guidelines, solicitation materials, and agreements to ensure they are meeting LCTOP requirements. All CARB co-benefit assessment methodologies are available at: [www.arb.ca.gov/cci-cobenefits](http://www.arb.ca.gov/cci-cobenefits).

## Methodology Development

CARB and Caltrans developed this LCTOP Quantification Methodology consistent with the guiding principles of California Climate Investments, including ensuring transparency and accountability,<sup>1</sup> to be used to estimate the outcomes of proposed projects, inform project selection, and track results of funded projects. The implementing principles ensure that the methodology:

- Applies at the project-level;
- Provides uniform methods to be applied statewide and is accessible by all applicants;
- Uses existing and proven tools and methods;
- Uses project-level data, where available and appropriate; and
- Results in GHG and air pollutant 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 LCTOP project types. CARB also consulted with Caltrans 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. CARB released the Draft LCTOP Quantification Methodology and Draft LCTOP Benefits Calculator Tool for public comment on November 22, 2019. This Final LCTOP Quantification Methodology and accompanying LCTOP Benefits Calculator Tool have been updated to address public comments, where appropriate.

CMAQ Methods were used as the basis for developing the GHG emission reduction estimates for certain project features, specifically TAC features.<sup>2</sup> The CMAQ Methods are a set of equations for evaluating the cost-effectiveness of certain types of transportation projects, including bicycle paths, vanpools, and new bus service. CARB

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<sup>1</sup> California Air Resources Board. [www.arb.ca.gov/cci-fundingguidelines](http://www.arb.ca.gov/cci-fundingguidelines)

<sup>2</sup> California Air Resources Board. Methods to Find the Cost-Effectiveness of Funding Air Quality Projects for Evaluating Motor Vehicle Registration Fee Projects and Congestion Mitigation and Air Quality Improvement Projects. May 2005. [www.arb.ca.gov/planning/tsaq/eval/eval.htm](http://www.arb.ca.gov/planning/tsaq/eval/eval.htm).

and the California Department of Transportation developed the CMAQ Methods, which are used statewide by transportation agencies to assess criteria and toxic pollutant emission reductions from transportation projects competing for State motor vehicle fee and federal CMAQ funding. All of the CMAQ Methods equations and assumptions needed for this quantification method are included in this document, and some assumptions have been modified as necessary. Therefore, the equations used in this Quantification Methodology are referred to as TAC Methods. The CMAQ Methods document can be accessed at: [www.arb.ca.gov/planning/tsaq/eval/eval.htm](http://www.arb.ca.gov/planning/tsaq/eval/eval.htm).

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. As they become available, co-benefit assessment methodologies are posted at: [www.arb.ca.gov/cci-cobenefits](http://www.arb.ca.gov/cci-cobenefits).

## Tools

The LCTOP Benefits Calculator Tool relies on CARB-developed emission factors. CARB has established a single repository for emission factors used in CARB benefits calculator tools, 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 calculator tools are developed and updated.

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

## Updates

CARB staff periodically review each quantification methodology and benefits calculator tool to evaluate their effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified. CARB updated the LCTOP Quantification Methodology from the previous version<sup>3</sup> to enhance the analysis and provide additional clarity. The changes include:

- Updated the data source of air pollutant emission factors and fuel consumption factors from EMFAC2014 to EMFAC2017;
- Added GHG and co-benefit calculations for DMUs/EMUs;
- Refined rail and ferry air pollutant emission factors to vary by engine tier;
- When quantifying reductions for “New Service” and “Technology Conversion” quantification methods, used mid-year (middle calendar year based upon the

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<sup>3</sup> Quantification Methodology for FY 2018-19. January 10, 2019.  
[https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/caltrans\\_lctop\\_finalqm\\_18-19.pdf](https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/caltrans_lctop_finalqm_18-19.pdf)



useful life) emission factors instead of averaging first and final year emission factors;

- Updated suggested default values to include length of average trip and adjustment factor by mode and length of average trip and average fare cost by transit agency;
- Separate local air pollutant emission reductions from remote air pollutant emission reductions;
- Included air pollutant emission factors from brake and tire wear; and
- Included air pollutant emission factors from idling.

## Program Assistance

CARB staff will provide feedback on the quantification portions of the LCTOP Allocation Requests to check if the methods described in this document are used to reasonably estimate GHG emission reductions and air pollutant emission co-benefits for the proposed project. Applicants should use the following resources for additional questions and comments:

- Questions on this document should be sent to: [GGRFProgram@arb.ca.gov](mailto:GGRFProgram@arb.ca.gov).
- For more information on CARB efforts to support implementation of GGRF investments, see: [www.arb.ca.gov/caclimateinvestments](http://www.arb.ca.gov/caclimateinvestments).
- Questions pertaining to LCTOP should be sent to: [LCTOPcomments@dot.ca.gov](mailto:LCTOPcomments@dot.ca.gov).

## Section B. Methods

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

### Project Types

Caltrans developed 15 project types that meet the objectives of LCTOP and have methods to quantify GHG emission reductions.<sup>4</sup> Other project features may be eligible for funding under LCTOP; however, each project requesting GGRF funding must include at least one of the following:

- New expanded/enhanced transit service;
- Alternative transportation services;
- Purchase replacement vehicle(s) and equipment/infrastructure in support of new expanded/enhanced transit service;
- Purchase, construct, and install equipment and facilities needed to provide expanded/enhanced transit service;
- Purchase expansion zero-emission vehicle(s) and equipment/infrastructure in support of new expanded/enhanced transit service;
- Purchase, construct, and/or install infrastructure to support zero-emission or low-emission vehicles in support of new expanded/enhanced transit service;
- Purchase, construct, and install renewable energy/fuel for transit facilities in support of new expanded/enhanced transit service;
- Purchase expansion zero-emission vehicle(s) (may include equipment/infrastructure);
- Purchase replacement zero-emission vehicle(s) (may include equipment/infrastructure);
- Purchase, construct, and/or install infrastructure, equipment, or facilities to support zero-emission vehicle(s);
- Purchase and install equipment on transit vehicles to encourage increased transit ridership;
- Purchase, construct, and/or install transit-related amenities or infrastructure to encourage increased transit ridership;
- Purchase and construct active transportation facilities that connect to stops/stations and encourage ridership;
- Free or reduced fares; and
- Network/fare integration.

<sup>4</sup> <https://dot.ca.gov/programs/rail-and-mass-transportation/low-carbon-transit-operations-program-lctop>

## General Approach

Methods used in the LCTOP Benefits Calculator Tool for estimating the GHG emission reductions and air pollutant emission co-benefits by quantification method are provided in this section. These methods account for emission reductions from displaced vehicle miles traveled, vehicle and equipment replacement, and the generation and use of renewable fuels/energy. The Database Documentation explains how emission factors used in CARB benefits calculator tools are developed and updated.

In general, the GHG emission reductions, air pollutant emission co-benefits, and key variables are estimated in the LCTOP Benefits Calculator Tool using the quantification approaches by project type outlined in Table 1 below.

**Table 1. General Approach to Quantification by Method**

New Service
<i>Emission Reductions = Emission Reductions from Displaced Autos – Emissions from New Service</i>
Increased Ridership
<i>Emission Reductions = Emission Reductions from Displaced Autos</i>
Technology Conversion
<i>Emission Reductions = Emissions from Displaced (Baseline) Vehicle – Emissions from New Vehicle</i>
Fuel/Energy Reductions
<i>Emission Reductions = Emission Reductions from Reduced Fuel/Energy Usage or Displaced Fuel/Energy Usage from Renewable Energy/Fuel Production</i>

Based upon the project type selected, one or a combination of the four quantification methods shown in Table 1 will apply. The 15 project types fall into five possible quantification method combinations, including additional optional quantification methods available dependent upon the project type, as shown in Table 2.

**Table 2. Project Types by Quantification Method**

<b>Project Type</b>	<b>Method</b>
New expanded/enhanced transit service	New Service (Optional Technology Conversion and Fuel/Energy Reductions)
Alternative transportation services	New Service (Optional Technology Conversion and Fuel/Energy Reductions)
Purchase, construct, and/or install infrastructure to support zero-emission or low-emission vehicle(s) in support of new expanded/enhanced transit service	New Service (Optional Technology Conversion and Fuel/Energy Reductions)
Purchase, construct, and/or install equipment and facilities needed to provide expanded/enhanced transit service	New Service (Optional Technology Conversion and Fuel/Energy Reductions)
Free or reduced fares	Increased Ridership (Optional Fuel/Energy Reductions)
Network/fare integration	Increased Ridership (Optional Fuel/Energy Reductions)
Purchase, construct, and/or install transit-related amenities or infrastructure to encourage increased transit ridership	Increased Ridership (Optional Fuel/Energy Reductions)
Purchase and construct active transportation facilities that connect to stops/stations and encourage ridership	Increased Ridership (Optional Fuel/Energy Reductions)
Purchase and install equipment on transit vehicles to encourage increased transit ridership	Increased Ridership (Optional Fuel/Energy Reductions)
Purchase expansion zero-emission vehicle(s) (may include equipment/infrastructure)	Technology Conversion (Optional Fuel/Energy Reductions)
Purchase replacement zero-emission vehicle(s) (may include equipment/infrastructure)	Technology Conversion (Optional Fuel/Energy Reductions)
Purchase construct, and/or install infrastructure, equipment, or facilities to support zero-emission vehicle(s)	Technology Conversion (Optional Fuel/Energy Reductions)
Purchase expansion zero-emission vehicle(s) and equipment/infrastructure in support of new expanded/enhanced transit service	New Service and Technology Conversion (Optional Fuel/Energy Reductions)
Purchase replacement vehicle(s) and equipment/infrastructure in support of new expanded/enhanced transit service	New Service and Technology Conversion (Optional Fuel/Energy Reductions)
Purchase, construct, and install renewable energy/fuel for transit facilities in support of new expanded/enhanced transit service <sup>5</sup>	New Service and Fuel/Energy Reductions

<sup>5</sup> For solar projects, use the National Renewable Energy Laboratory PVWatts Calculator to calculate the annual energy (kWh) expected to be generated from the solar panels. The energy generated will be

## A. Emission Reductions from New Service

Equation 1 estimates both the GHG and air pollutant emission reductions from New Service, calculated as the difference between the emission reductions from displaced autos and emissions associated with operation of the new service.

### Equation 1: Emission Reductions from New Service

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

Equation 2 calculates the total emission reductions associated with auto VMT displaced by the new service.

### Equation 2: Emission Reductions from Displaced Auto VMT

$E_{Reduced} = \frac{E_{Reduced\_Yr1} + E_{Reduced\_YrF}}{2} \times QP$			
Where,			
$E_{Reduced}$	=	Total emission reductions from displaced auto VMT	Units MTCO <sub>2</sub> e or lbs
$E_{Reduced\_Yr1}$	=	Emission reductions from displaced autos in first year	MTCO <sub>2</sub> e or lbs
$E_{Reduced\_YrF}$	=	Emission reductions from displaced autos in final year	MTCO <sub>2</sub> e or lbs
$QP$	=	Quantification period	years

Equation 3 calculates the annual emission reductions associated with auto VMT displaced from the project.

### Equation 3: Annual Emission Reductions from Displaced Auto VMT

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

entered into the LCTOP Calculator Tool as a Fuel/Energy Reduction with electric selected as the fuel type. The PVWatts tool can be accessed at: <http://pvwatts.nrel.gov/>.

Equation 4 calculates the annual auto VMT displaced by the new service.

**Equation 4: Annual Auto VMT Displaced**

$$AutoVMT_{Yr} = R_{Yr} \times A \times L$$

Where,		Units
$AutoVMT_{Yr}$	= Annual auto VMT displaced in the first or final year	miles
$R_{Yr}$	= Annual increase in unlinked passenger trips directly associated with the first or final year of the project	riders
$A$	= Adjustment factor to account for transit dependency. Use documented, project-specific data or system average developed from recent, statistically-valid survey or default. Applicants may use default values in Appendix A for similar service.	unitless
$L$	= Estimated length of average unlinked passenger trip directly associated with the project, calculated as passenger-miles divided by unlinked trips. Applicants may use data reported to National Transit Database (Appendix A) for similar service.	mile(s) per rider

Equation 5 calculates the total emissions associated with the operation of the new service.

**Equation 5: Emissions from New Service**

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

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

Equation 6 calculates the annual emission estimates associated with the operation of the new service. For train and ferry services, annual emissions may alternatively be calculated based upon inputs for annual fuel consumption. Train services include heavy rail, light rail, and DMUs/EMUs.

**Equation 6: Annual Emissions from New Service**

$AE_{New} = \frac{NSVMT \times NSEF \times HDR}{CF}$		<p><b>Or (for train/ferry service only)</b></p>	$AE_{New} = \frac{NSFuel \times FuelEF \times HDR}{CF}$	
<p>Where,</p>			<p><u>Units</u></p>	
$AE_{New}$	=	Average annual emissions from new service		MTCO <sub>2</sub> e/yr or lbs/yr
$NSVMT$	=	Estimated annual VMT attributed to the operation of the new service		miles
$NSEF$	=	Emission factor based on service type, in the mid-year of the project		grams/mile
$NSFuel$	=	Estimated annual fuel attributed to the operation of the new service - only available for train and ferry services		unit of fuel
$FuelEF$	=	Emission factor based on fuel type, and engine tier for train, in the mid-year of the project		grams/unit of fuel
$HDR$	=	Hybrid discount rate (0.8), if applicable		unitless
$CF$	=	Conversion factor		grams/MT or grams/lb

## B. Emission Reductions from Increased Ridership

Equation 7 estimates the GHG and air pollutant emission reductions from Increased Ridership as the emission reductions from displaced auto VMT.

### Equation 7: Emission Reductions from Increased Ridership

$E = E_{Reduced}$			
Where,			
$E$	=	Net emission reductions	Units MTCO <sub>2</sub> e or lbs
$E_{Reduced}$	=	Total emission reductions from displaced auto VMT	MTCO <sub>2</sub> e or lbs

Equation 8 calculates the total emission reductions associated with auto VMT displaced.

### Equation 8: Emission Reductions from Displaced Auto VMT

$E_{Reduced} = \frac{E_{Reduced\_Yr1} + E_{Reduced\_YrF}}{2} \times QP$			
Where,			
$E_{Reduced}$	=	Total emission reductions from displaced auto VMT	Units MTCO <sub>2</sub> e or lbs
$E_{Reduced\_Yr1}$	=	Emission reductions from displaced autos in first year	MTCO <sub>2</sub> e or lbs
$E_{Reduced\_YrF}$	=	Emission reductions from displaced autos in final year	MTCO <sub>2</sub> e or lbs
$QP$	=	Quantification period	years

Equation 9 calculates the annual emission reductions associated with auto VMT displaced.

### Equation 9: Annual Emission Reductions from Displaced Auto VMT

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



Equation 10 calculates the annual auto VMT displaced from the project.

**Equation 10: Annual Auto VMT Displaced in Miles per Year**

$$AutoVMT_{Yr} = R_{Yr} \times A \times L$$

Where,		Units
$AutoVMT_{Yr}$	= Annual auto VMT displaced in the first or final year	miles
$R_{Yr}$	= Annual increase in unlinked passenger trips directly associated with the first or final year	riders
$A$	= Adjustment factor to account for transit dependency. Use documented, project-specific data or system average developed from recent, statistically-valid survey or default. Applicants may use default values in Appendix A for similar service.	unitless
$L$	= Estimated length of average unlinked passenger trip directly associated with the project, calculated as passenger-miles divided by unlinked trips. Applicants may use data reported to National Transit Database (Appendix A) for similar service.	mile(s) per rider

### C. Emission Reductions from Technology Conversion

Equation 11 estimates both the GHG and air pollutant emission reductions from Technology Conversion as the difference between the emissions associated with the baseline vehicle and emissions associated with the new vehicle.

#### Equation 11: Emission Reductions from Cleaner Vehicles / Technology / Fuels

$E = E_{Vehicle\_Baseline} - E_{Vehicle\_New}$		
Where,		
$E$	= Net emission reductions	Units MTCO <sub>2</sub> e or lbs
$E_{Vehicle\_Baseline}$	= Total emissions from baseline vehicle	MTCO <sub>2</sub> e or lbs
$E_{Vehicle\_New}$	= Total emissions from new vehicle	MTCO <sub>2</sub> e or lbs

Equation 12 calculates the emissions associated with the baseline and new vehicles.

#### Equation 12: Emissions from Baseline or New Vehicle

$E_{Vehicle} = AE_{Vehicle} \times QP$		
Where,		
$E_{Vehicle}$	= Total emissions from baseline or new vehicle(s)	Units MTCO <sub>2</sub> e or lbs
$AE_{Vehicle}$	= Average annual emissions from the baseline or new vehicle	MTCO <sub>2</sub> e/yr or lbs/yr
$QP$	= Quantification period	years

Equation 13 calculates the annual emissions associated with the baseline and new vehicles. For train and ferry services, annual emissions may be calculated based upon inputs for annual fuel consumption. Train services include heavy rail, light rail, and DMUs/EMUs.

#### Equation 13: Annual Emissions from Baseline or New Vehicle

$AE_{Vehicle} = \frac{VMT \times VehicleEF \times HDR}{CF}$ Or (for train/ferry only) $AE_{Vehicle} = \frac{Fuel \times FuelEF \times HDR}{CF}$		
Where,		
$AE_{Vehicle}$	= Average annual emissions from the displaced or new vehicle	Units MTCO <sub>2</sub> e/yr or lbs/yr
$VMT$	= Estimated annual VMT of the vehicle to be acquired	mile/yr
$VehicleEF$	= Emission factor, based on project-specific inputs for the current or new vehicle, from the mid-year of the project	grams/mile
$Fuel$	= Estimated annual fuel of the vehicle to be acquired, only available for train and ferry services	unit of fuel
$FuelEF$	= Emission factor based on fuel type, and engine tier for train, for the displaced or new vehicle, in the mid-year of the project	grams/unit of fuel
$HDR$	= Hybrid discount rate (0.8), if applicable	unitless
$CF$	= Conversion factor	grams/MT or grams/lb

For the acquisition of a new zero-emission vehicle where there is no current vehicle to be replaced, applicants will enter current vehicle information of the newest available fossil fuel-equivalent vehicle. For example, if the project was to purchase a zero-emission vehicle that would be operational in 2021, the applicant should input a 2021 model year fossil fuel vehicle in place of the current vehicle information.

For the acquisition of a new vehicle where there is a current vehicle to be replaced, the LCTOP Calculator Tool requires project-specific inputs regarding the current vehicle to calculate the emission estimates.

## D. Emission Reductions from Fuel/Energy Reduction

Equation 14 estimates the GHG and air pollutant emission reductions from Fuel/Energy Reduction as the emission reductions from reduced fuel or energy usage.

### Equation 14: Emission Reduction Estimates from Fuel/Energy Reduction

$E = AE_{Fuel/Energy} \times QP$		
Where,		
$E$	= Net emission reductions	Units MTCO <sub>2</sub> e or lbs
$AE_{Fuel/Energy}$	= Annual emission reductions from fuel/energy reduction	MTCO <sub>2</sub> e/yr or lbs/yr
$QP$	= Quantification period	years

Equation 15 calculates the annual GHG emission reductions associated with fuel/energy reduction.

### Equation 15: Annual GHG Emission Reductions from Fuel/Energy Reduction

$AE_{Fuel/Energy\_GHG} = \frac{Fuel \times FuelEF \times ED}{CF}$		
Where,		
$AE_{Fuel/Energy\_GHG}$	= Annual GHG emission reductions from fuel/energy reduction	Units MTCO <sub>2</sub> e/yr
$Fuel$	= Estimated annual fuel/energy reductions	unit of fuel/yr
$FuelEF$	= GHG emission factor, based on fuel type and mid-year of the project	grams/MJ
$ED$	= Energy density, based on fuel type	MJ/ unit of fuel
$CF$	= Conversion factor	grams/MT

Equation 16 calculates the annual air pollutant emission reductions associated with fuel/energy reduction.

### Equation 16: Annual Air Pollutant Emission Reductions from Fuel/Energy Reduction

$AE_{Fuel/Energy\_AP} = \frac{Fuel \times FuelCR \times FuelEF}{CF}$		
Where,		
$AE_{Fuel/Energy\_AP}$	= Annual air pollutant emission reductions from fuel/energy reductions	Units lbs/yr
$Fuel$	= Estimated annual fuel/energy reductions	unit of fuel/yr
$FuelCR$	= Fuel consumption rate of the vehicle from the mid-year of the project	miles/unit of fuel
$FuelEF$	= Air pollutant emission factor based on fuel type, from the mid-year of the project	grams/mile
$CF$	= Conversion factor	grams/MT

## Section C. References

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

California Air Resources Board. (2019). California Climate Investments Quantification Methodology Emission Factor Database. <http://www.arb.ca.gov/cci-resources>

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

National Renewable Energy Laboratory. (2012). Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics. <https://www.nrel.gov/docs/fy13osti/56487.pdf>

National Renewable Energy Laboratory. (2017). PV Watts Calculator. <https://pwwatts.nrel.gov/>

## Appendix A. Default Lookup Tables

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>6</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>7</sup>.

**Table A-1. 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	0.705
Commuter Bus (Express/Intercity)	CB	PT	21.83	0.705
Cable Car	CC	DO	1.26	0.479
Commuter Rail	CR	PT	25.69	0.867
Demand Response	DR	DO	9.08	0.540
Demand Response	DR	PT	9.94	0.540
Demand Response Taxi	DT	PT	12.35	0.540
Ferryboat	FB	DO	10.85	1
Ferryboat	FB	PT	15.01	1
Heavy Rail	HR	DO	11.48	0.794
Light Rail	LR	DO	5.44	0.685
Bus (Local)	MB	DO	3.77	0.561 (Transit Bus) 0.585 (Shuttle)
Bus (Local)	MB	PT	4.27	0.561 (Transit Bus) 0.585 (Shuttle)
Monorail/Automated Guideway	MG	PT	3.18	0.479
Bus Rapid Transit	RB	DO	6.56	0.542
Streetcar Rail	SR	DO	1.43	0.479
Trolley Bus	TB	DO	1.48	0.479
Vanpool	VP	DO	42.28	0.879

<sup>6</sup> Federal Transit Administration. National Transit Database. Available at <https://www.transit.dot.gov/ntd>.

<sup>7</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)

Mode Type	Mode	Type of Service	Length of Average Trip (Miles/Trip)	Adjustment Factor
Vanpool	VP	PT	44.27	0.879
Hybrid Rail	YR	PT	8.58	0.738

Table A-2. 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

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



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

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

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

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

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