

## Documentation of GHG (Green House Gas) Reduction Assumptions

This document demonstrates the reasonableness of our GHG emission reduction estimates. Within this section, you will find a detailed explanation of the methodology and assumptions utilized in developing the estimated GHG emission reductions associated with each of VTA's proposed Measures.

For a comprehensive understanding of the quantification used to calculate the anticipated emission reductions for each GHG reduction measure, please refer to the GHG Reduction Calculations Spreadsheets attached to the Project Narrative Form.

### T-2: Implement the VTA Visionary Transit Network (Microtransit and Shuttle Services)

For the Visionary Transit Network measure, we estimate CO<sub>2</sub>-equivalent (CO<sub>2</sub>-e) metric tons and cost effectiveness by using the fiscal year ending (FYE) 2025 "Cost-Effectiveness Worksheet" developed by the Bay Area Air Quality Management District (BAAQMD). The worksheet was developed to calculate GHG emissions and cost effectiveness for projects applying for regional Transportation Fund for Clean Air (TFCA) funds. The worksheet is described in further detail in Appendix H of the ["TFCA 40% Fund Expenditure Plan Guidance FYE 2025"](#) document.

City/County	Annual MT CO <sub>2</sub> -e	Cumulative MT CO <sub>2</sub> -e for Requested CPRG Funding	*Cumulative 2025 through 2030 MT CO <sub>2</sub> -e	*Cumulative 2025 through 2050 MT CO <sub>2</sub> -e	*Cost Effectiveness (Cost/MT CO <sub>2</sub> -e 2025 – 2030)
<b>Cupertino</b>	1,326	2,653 (2-years)	7,958	34,486	\$1,241/MT CO <sub>2</sub> -e
<b>Milpitas</b>	765	3,826 (5-years)	4,591	19,893	\$2,109/MT CO <sub>2</sub> -e
<b>Morgan Hill</b>	412	2,058 (5-years)	2,469	10,699	\$3,227/MT CO <sub>2</sub> -e
<b>San Jose</b>	1,468	7,342 (5-years)	8,810	38,176	\$1,979/MT CO <sub>2</sub> -e
<b>Sunnyvale</b>	1,511	7,554 (5-years)	9,065	39,282	\$2,538/MT CO <sub>2</sub> -e
<b>Gilroy</b>	430	2,149 (5-years)	2,579	11,176	\$3,836/MT CO <sub>2</sub> -e
<b>San Benito County</b>	497	497 (1-year)	2,984	12,932	\$212/MT CO <sub>2</sub> -e
<b>Totals</b>			<b>38,456</b>	<b>166,644</b>	<b>\$2,041 per MT/CO<sub>2</sub>-e</b>

\*Assumes continuation of services beyond available CPRG funding.

The following describes our assumptions and calculations for determining GHG emissions and cost effectiveness by using the BAAQMD's "Cost-Effectiveness Worksheet."

## TFCA Worksheet Assumptions for Microtransit and Shuttle Projects:

Assumptions and Sources	Spreadsheet Reference
1-way Commute Trip Length (Step 1) = 16 Miles (recommended by the Metropolitan Transportation Commission's Commute Profile)	<b>Tab – CE Calcs:</b> 1-way Commute Trip Length = C14
1-way Transit/Shuttle Trip Length (Step 2) = 3 Miles (recommended by BAAQMD)	<b>Tab – CE Calcs:</b> 1-way Trip Length = C21
Commuting Days/Year (Steps 1 & 2) = 240 Days (recommended by BAAQMD)	<b>Tab – CE Calcs:</b> Commuting Days/Year = B14 & B21

## TFCA Worksheet Inputs for Microtransit and Shuttle Projects:

Inputs and Sources	Spreadsheet Reference
Inbound Commuters (commuting into the zone) = Collected from United States (U.S.) Census "On the Map" tool based on microtransit service zone. <b>NOTE:</b> This only applies to Microtransit. This does not apply to the San Benito Shuttle, which only considers number of residents.	<b>Tab – Notes &amp; Assumptions:</b> Inbound Commuters (commuting into the zone) = B12 See "On the Map" tool screenshot at the bottom of the sheet.
Residential population estimate = Collected from Remix and 2020 Census Estimates.	<b>Tab – Notes &amp; Assumptions:</b> Residential population estimate = B11
# of 1-way Trips/Day Eliminated = (1% of target population) x [(Inbound Commuters) + (Residential Population)] <b>NOTE:</b> For the San Benito Shuttle Bus, the equation changes to: (0.1% of target population) x (Residential Population)	<b>Tab – Notes &amp; Assumptions:</b> $B14 = (0.01) \times (B11 + B12)$ B14 is inputted into the "CE Calcs" tab, cell A14
Number of vehicles = Provided by the cities.	<b>Tab – Notes &amp; Assumptions:</b> Number of vehicles = B17
Average length of trip = Provided by cities or Remix.	<b>Tab – Notes &amp; Assumptions:</b> Average length of trip = B18
# of one-way trips per day = Provided by cities or Remix.	<b>Tab – Notes &amp; Assumptions:</b> # of one-way trips per day = B19

Inputs and Sources	Spreadsheet Reference
# of days of service / year = 350  Number of days the microtransit & shuttle services are in operation (provided by Via).	<b>Tab – Notes &amp; Assumptions:</b>  # of days of service / year = B20
# Years of Effectiveness = Number of Years of Requested EPA (Environmental Protection Agency) CPRG Funding.	<b>Tab – CE Calcs:</b>  # Years of Effectiveness = K2

### Step 1 in TFCA Worksheet- Emissions for Eliminated Trips

Step #	Operations	Spreadsheet Reference
1	<b><i>Annual VMT (Vehicles Mile Traveled) of Eliminated SOV Trips =</i></b> (# of 1-way Trips/Day eliminated) x (Days/Year) x (1-way Commute Trip Length)	<b>Tab – CE Calcs:</b>  D14 = (A14) x (B14) x (C14)
2	The TFCA Calculator multiplies <b><i>Annual VMT of Eliminated SOV Trips</i></b> by the appropriate emissions factors to provide NOx gr/Year and CO2 gr/Year.  NOx gr/Year = (Annual VMT of Eliminated SOV Trips) x (Emission Factors from “Emission Factors” Tab)  CO2 gr/Year = (Annual VMT of Eliminated SOV Trips) x (Emission Factors from “Emission Factors” Tab)	<b>Tab – CE Calcs:</b>  F14 = (D14) x (NOx Emission Factors from “Emission Factors” Tab)  I14 = (D14) x (CO2 Emission Factors from “Emission Factors” Tab)

### Step 2 in TFCA Worksheet- Emissions for New Trips to Access Transit/Ridesharing

Step #	Operations	Spreadsheet Reference
1	<b><i>Annual VMT of New Microtransit or Shuttle Trips =</i></b> [# of 1-way Trips per Day eliminated/2] x (Days/Year) x (1-way Trip Length)	<b>Tab – CE Calcs:</b>  D14 = (A21) x (B21) x (C21)  A21 = (A14)/2

Step #	Operations	Spreadsheet Reference
2	<p>The TFCA Calculator multiplies <b>Annual VMT of New Microtransit or Shuttle Trips</b> by the appropriate emissions factors to provide NOx/Year and CO2/Year Emissions.</p> <p>NOx gr/Year =            (Annual VMT of New Microtransit or Shuttle Trips) x (Emission Factors from "Emission Factors" Tab)</p> <p>CO2 gr/Year =            (Annual VMT of New Microtransit or Shuttle Trips) x (Emission Factors from "Emission Factors" Tab)</p>	<p><b>Tab – CE Calcs:</b></p> <p>F21 =            (D21) x (NOx Emission Factors from "Emission Factors" Tab)</p> <p>I21 =            (D21) x (CO2 Emission Factors from "Emission Factors" Tab)</p>

**Step 3A in TFCA Worksheet- Emissions for Shuttle/Vanpool Vehicles up to GVW of 14,000 lbs.**

Step #	Operations	Spreadsheet Reference
1	<p><b>Annual VMT of Microtransit or Shuttle Vehicles =</b>            (Number of Vehicles) x (Average Trip Length) x (# of One-Way Trips per Day) x (# of days of service/year)</p>	<p><b>Tab – Notes &amp; Assumptions</b></p> <p>B16 =            (B17) x (B18) x (B19) x (B20)</p> <p>B16 is inputted into the "CE Calcs" tab, cell I29</p>
2	<p>The TFCA Calculator multiplies <b>Annual VMT of Microtransit or Shuttle Vehicles</b> by the appropriate emissions factors to provide NOx/Year and CO2/Year Emissions.</p> <p>NOx gr/Year =            (Annual VMT of Microtransit or Shuttle Vehicles) x (Emission Factors from "Emission Factors" Tab)</p> <p>CO2 gr/Year =            (Annual VMT of Microtransit or Shuttle Vehicles) x (Emission Factors from "Emission Factors" Tab)</p>	<p><b>Tab – CE Calcs:</b></p> <p>K29 =            (I29) x (NOx Emission Factors from "Emission Factors" Tab)</p> <p>N29 =            (I29) x (CO2 Emission Factors from "Emission Factors" Tab)</p>

## Calculating Annual CO<sub>2</sub> and NO<sub>x</sub> Emissions (Using Results from Steps 1-3)

Operations	Spreadsheet Reference
<b>Metric Tons CO<sub>2</sub>/Year or NO<sub>x</sub>/Year =</b> [(Emissions for Eliminated Trips) – ((Emissions for New Trips to Access Transit/Ridesharing) + (Emissions for Shuttle/Vanpool Vehicles))] / 907200 Grams per Metric Ton  <b>OR</b> [(Step 1 NO <sub>x</sub> or CO <sub>2</sub> Emissions) – ((Step 2 NO <sub>x</sub> or CO <sub>2</sub> Emissions) + (Step 3 NO <sub>x</sub> or CO <sub>2</sub> Emissions))] / 907200 Grams per Metric Ton	<b>Tab – CE Calcs:</b>  G46 = [(F18) - ((F23) + (K31))] / 907200  G49 = [(I18) - ((I23) + (N31))] / 907200

## Converting NO<sub>x</sub> to CO<sub>2</sub>-Equivalent

Operations	Spreadsheet Reference
To convert Nitrous Oxide (NO <sub>x</sub> ) emissions to CO <sub>2</sub> -equivalent, multiple by 265, per the NOFO's Appendix B.  <b>Note:</b> The TFCA Calculator does not calculate Methane (CH <sub>4</sub> ) emissions.	<b>Tab – CE Calcs:</b>  K46 = (G46) x (J46)

## Calculating CO<sub>2</sub>-Equivalents

Operations	Spreadsheet Reference
<b>Annual CO<sub>2</sub>-Equivalent =</b> (Annual CO <sub>2</sub> ) + (Annual NO <sub>x</sub> Converted to CO <sub>2</sub> -e)	<b>Tab – CE Calcs:</b>  K50 = K46 + K49  Note: K49 = G49
<b>Magnitude of GHG Reductions for Years Funded by EPA CPRG =</b> (Annual CO <sub>2</sub> -Equivalent) x (years of requested EPA CPRG funding)	<b>Tab – CE Calcs:</b>  M54 = [(K46) x (L46)] + [(K49) + (L49)]  Note: L46 & L49 = K3
<b>Magnitude of GHG Reductions from 2025 through 2030 (assuming service goes beyond requested years of EPA CPRG funding) =</b> (Annual CO <sub>2</sub> -Equivalent) x 6 years	<b>Tab – CE Calcs:</b>  Q54 = [(P46) x 6] + [(G49) x 6]

Operations	Spreadsheet Reference
<b>Magnitude of GHG Reductions from 2025 through 2050 (assuming service goes beyond requested years of EPA CPRG funding) =</b> (Annual CO <sub>2</sub> -Equivalent) x 26 years	<b>Tab – CE Calcs:</b>  R54 = $[(P46) \times 26] + [(G49) \times 26]$

### Calculating Cost Effectiveness

Operations	Spreadsheet Reference
<b>2025-2030 GHG Reduction Cost Effectiveness =</b> (Total Cost of Microtransit or Shuttle Service) / (Magnitude of GHG Reductions from 2025 through 2030)	<b>Tab – CE Calcs:</b>  QR57 = $P57 / Q54$  Note: P47 pulled from Budget Spreadsheet

### Additional Comments

Within the “CE Calcs” tab, cells K5, K6, K7, K8, H51, & H52 can be ignored by Technical Appendix reviewers. These cells are for calculating TFCA cost share for transportation projects. This does not apply to the EPA CPRG grant application.

## T-4: Implement Transit Signal Priority (TSP) Programs to Reduce Wait Times and Idling for Public Transit

	Annual MT CO <sub>2</sub> -e	Cumulative MT CO <sub>2</sub> -e for Requested CPRG Funding	Cumulative 2025 through 2030 MT CO <sub>2</sub> -e	Cumulative 2025 through 2050 MT CO <sub>2</sub> -e	Cost Effectiveness (Cost/MT CO <sub>2</sub> -e 2025 – 2030)
<a href="#">TSP</a>	N/A	948	942	948	\$20,537/MT CO <sub>2</sub> -e

VTA's CAAP (Climate Action and Adaptation Plan) has analyzed the estimated GHG emission reductions for various climate action measures spanning different horizon years. The TSP measure is projected to have specific reductions in GHG emissions as described in the following.

For the year 2030, these measures are estimated to reduce 942 metric tons of carbon dioxide. However, the reduction diminishes significantly over time. By 2040, it is projected to reduce only six metric tons of carbon dioxide, and beyond 2040, no further reductions are anticipated. This decline in carbon dioxide reduction beyond 2030 is attributed to the electrification of VTA's bus fleet. There are federal and State of California mandates in place requiring all buses to be zero-emissions by 2035 and 2040, respectively. As a result, the impact of the TSP signal priority and associated measures on carbon dioxide reduction diminishes as the fleet transitions to zero-emission vehicles.

The basis of the emission calculations was as follows:

- A 20% increase in bus speed by 2040, per the VTA's Visionary Network plan (20 percent represents the middle of the range of the plan's possible increases of 10 to 30 percent).
- A current average bus speed of 11.6 miles per hour was assumed. These increases in bus speed result in increased fuel efficiency (and therefore less fuel consumption and lower emissions).
- A 1.33% speed increase per year as percent of baseline year values.
- To quantify this reduction in fuel consumption, data on the relationship between bus speed and fuel consumption from the California Air Resources Board's Emission Factor 2021 Model (EMFAC) was used (CARB (California Air Resources Board) 2023).

For further information on the emission calculations, please refer to [Appendix C in VTA's CAAP](#).

Model calculations are provided in this [Excel Sheet, under tab TL3.2](#).

## Final Cumulative Results

The following table summarizes the cumulative CO2-e reductions for the entire CPRG application.

GHG Reduction Measure	Cumulative 2025 through 2030 MT CO2-e	Cumulative 2025 through 2050 MT CO2-e	Measure Cost	Cost Effectiveness (Cost/MT CO2-e 2025 – 2030)
<b>T-2 – Visionary Transit Network</b>	*38,456	*166,644	\$78,489,477	\$2,041 per MT/CO2-e
<b>T-4 – Transit Signal Priority</b>	942	948	\$19,346,133	\$20,537 per MT/CO2-e
<b>Totals</b>	<b>39,398</b>	<b>167,592</b>	<b>\$97,835,610</b>	<b>\$2,483 per MT/CO2-e</b>

\*Assumes continuation of services beyond available CPRG funding.