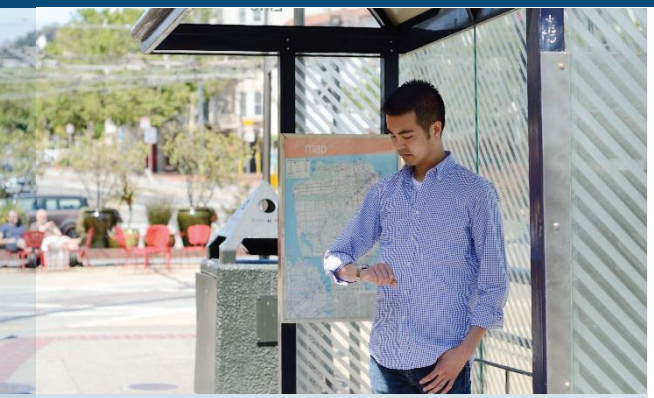
T-46. Provide Transit Shelters



GHG Mitigation Potential

Up to 0.32% of GHG emissions associated with plan/community VMT

Co-Benefits (icon key on pg. 34)

Climate Resilience

Transit shelters protect passengers from extreme weather, such as high temperatures and heavy precipitation. Providing transit shelters can also incentivize more people to use transit, resulting in less traffic and better allowing emergency responders to access a hazard site during an extreme weather event.

Health and Equity Considerations

Transit shelters can increase shade and provide heat mitigation for waiting passengers. Transit shelters also provide rest areas for people with disabilities and pregnant passengers. Increased access to safe, efficient, comfortable, and well-maintained public transit promotes physical activity and results in reduced health risk.

Measure Description

For this measure, a local government or transit agency provides amenities that make it safer and more comfortable to wait for the bus. The two interventions that have proven to lead to changes in rider perceptions are adding bus shelters and adding real-time arrival information. Research into transit ridership shows that adding these amenities decreases both the real and the perceived wait time for riders, which impacts riders' willingness to ride.

Subsector

Transit

Locational Context

Urban, suburban

Scale of Application

Plan/Community

Implementation Requirements

This measure requires that bus shelters also have benches because the combined effect of shelters and benches was measured in the studies cited.

Cost Considerations

Providing amenities requires capital investment to construct bus shelters and improve passenger communication systems to relay arrival information. Staff and maintenance costs may also increase. A portion of these costs may be offset by increased transit ridership and associated income. Increased ridership also reduces vehicle use, which has cost benefits for both commuters and municipalities.

Expanded Mitigation Options

When adding bus shelters, providing lighting is recommended as it increases rider perceptions of safety at night.

GHG Reduction Formula

$$A1 = B \times \frac{C}{D} \times E \times \frac{F}{G} \times (H\text{-}I1) \times J \text{ (for bus shelters only)}$$

$$A2 = B \times \frac{C}{D} \times E \times \frac{F}{G} \times (H\text{-}I2) \times J \text{ (for bus shelters and real-time arrival information)}$$

GHG Calculation Variables

ID	Parameter	Value	Unit	Source
Output				
A1, A2	Percent reduction in GHG emissions from vehicle travel in plan/community	0–0.32	%	calculated
User Inputs				
B	Number of transit stops with new bus shelters and benches	[ ]	unitless	user input
C	Average number of boardings per day at each transit station with added amenities	[ ]	boardings/day	user input
D	Average number of boardings per day across the transit agency	[ ]	boardings/day	user input
E	Transit mode share in the core-based statistical area	Table T-3.1	%	FHWA 2017
Constants, Assumptions, and Available Defaults				
F	Percent of transit users who would otherwise drive	83.3	%	FHWA 2017
G	Average auto occupancy	1.45	riders/vehicle	FHWA 2023
H	Percent of total travel time spent waiting (transit trips)	24.9	%	FHWA 2023
I1	Percent of perceived total travel time spent waiting (transit trips with shelters)	20.3	%	Fan 2016
I2	Percent of total travel time spent waiting (transit trips with shelters and real-time arrival information [RTI])	15.8	%	Watkins 2011
J	Wait time elasticity	-0.54	unitless	Taylor et al. 2009

Further explanation of key variables:

- (B) – This input is the number of bus stops that get equipped with new amenities (either shelters or shelters and real-time information).
- (C) – This input is the average number of boardings per day at the bus stop before the new amenities are added.

- (D) – This input is the average number of boardings per day across the entire transit agency.
- (E) – This is the transit mode share in the city where the bus amenities are being added. It is recommended that users use local data from the California extension of the NHTS or the U.S. Census for where the project(s) is located. The user can also use the values for CBSAs in the case where the projects are spread out across multiple cities.
- (F) – This constant is based on the percentage of trips taken by car from NHTS, weighted by transit ridership and number of cars available in the household to account for the fact that some riders do not have a choice to take transit and would ride regardless of the wait time. This value from FHWA 2018 represents pre-COVID-19 pandemic conditions but is the most recent value from FHWA.
- (G) – This is the average car occupancy for trips taken as of the latest version of the NHTS in 2022. This value accounts for the effects of the COVID-19 pandemic.
- (H) – This value represents the percentage of the total transit trip travel time that is composed of waiting and is derived from average wait times and travel times in the NHTS in the Pacific region.
- (I1, I2) – This represents the percentage of the total transit trip travel time that is composed of waiting after the addition of transit amenities. This is derived from the average wait times and travel times in the NHTS and the perceived wait time changes found in Fan 2016 and Watkins 2011.
- (J) – This elasticity is sourced from a study (Taylor et al. 2009) that uses data from LA Metro to estimate the effect of wait time and travel time on ridership across the system.

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) The percent reduction in GHG emissions (A) is capped at 0.32 percent. This assumes that the CBSA is San Francisco-Oakland-Hayward, which has a default transit mode share for all trips of 11.38 percent.

Subsector Maximum

($\sum A_{max_{T\text{-}25 \text{ through } T\text{-}29,\ T\text{-}46}} \leq 15\%$) This measure is in the Transit subsector. This subcategory includes Measures T-25 through T-29 and T-46. The VMT reduction from the combined implementation of all measures within this subsector is capped at 15 percent.

Example GHG Reduction Quantification

The user reduces VMT by constructing twelve transit shelters in Oakland with real time information for a bus system that has an average of 15,000 boardings per day (D) and

$$A = 12 \times \frac{300}{15{,}000} \times 11.38\% \times \frac{83.3\%}{1.45} \times (24.9\% - 15.8\%) \times -0.54 = -0.077\%$$

300 boardings per day at each of the stops (C) before the project. This leads to a reduction in transportation related GHG emissions of 0.077 percent.

Quantified Co-Benefits

Improved Air Quality

The percent reduction in GHG emissions (A) would be the same as the percent reduction in NOx, CO, NO_2, SO_2, and PM. Reductions in ROG emissions can be calculated by multiplying the percent reduction in GHG emissions (A) by an adjustment factor of 87 percent. See *Adjusting VMT Reductions to Emission Reductions* for further discussion.

Energy and Fuel Savings

The percent reduction in vehicle fuel consumption achieved by the measure would be the same as the percent reduction in GHG emissions (A).

VMT Reductions

The percent reduction in VMT achieved by the measure would be the same as the percent reduction in GHG emissions (A).

Sources

- Fan, Y., A. Guthrie, and D. Levinson. 2016. Waiting time perceptions at transit stops and stations: Effects of basic amenities, gender, and security. Transportation Research Part A: Policy & Practice 88:251–264. Available: https://doi.org/10.1016/j.tra.2016.04.012. Accessed: December 2023.
- Federal Highway Administration (FHWA). 2017. 2017 National Household Travel Survey. Available: https://nhts.ornl.gov/. Accessed: December 2023.
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- Taylor, B. D., H. Iseki, M. Smart, and M. A. Miller. 2009. The Effects of Out-of-Vehicle Time on Travel Behavior: Implications for Transit Transfers. California PATH Program. Available: https://trid.trb.org/view/886713. Accessed: December 2023.
- Watkins, K., B. Ferris, A. Borning, G. Scott Rutherford, and D. Layton. 2011. Where Is My Bus? Impact of mobile real-time information on the perceived and actual wait time of transit riders. Transportation Research Part A: Policy & Practice 45:839–848. Accessed: December 2023.