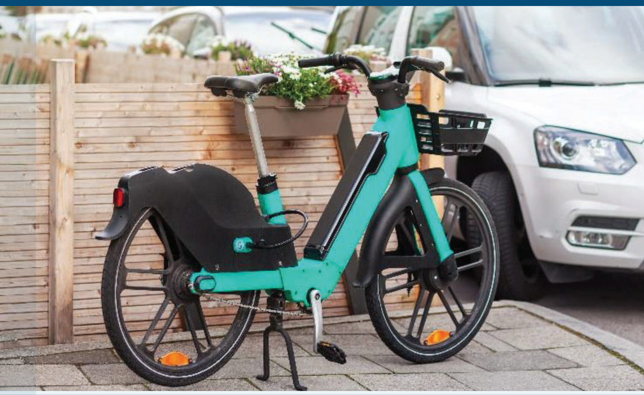
T-22-D. Transition Conventional to Electric Bikeshare



GHG Mitigation Potential

.059%

Up to 0.059% of GHG emissions from transitioning an existing traditional bikeshare system to electric bikes.

Co-Benefits (icon key on pg. 34)

Climate Resilience

Bikeshare programs can incentivize more bicycle use and decrease vehicle use, which have health benefits and can thus improve community resilience. This can also improve connectivity between residents and resources that may be needed in an extreme weather event. However, they may decrease resilience if they are the only option available during a power outage.

Health and Equity Considerations

Commuters who switch from passenger vehicle use to electric bicycle use initiate regular physical activity, reducing their health risk. Electric bicycles are more affordable than owning a car and can improve access to healthcare and other health-promoting goods and services. Program implementers should provide inclusive mechanisms so people without bank accounts, credit cards, or smart phones can access the system.

Measure Description

This measure accounts for the VMT reduction achieved by transitioning an existing traditional bikeshare program to an electric bikeshare program. Research in California has found that electric bikeshare programs lead to increased ridership and accessibility over traditional bikes. This makes sense because, with an electric bike, it is easier to climb hills and is more enjoyable and faster for riders to get where they are going, leading to increased utility. Variations of this measure are described in Measure T-22-A, *Implement Pedal (Non-Electric) Bikeshare Program*, Measure T-22-B, *Implement Electric Bikeshare Program*, and Measure T-22-C, *Implement Scootershare Program*.

Subsector

Neighborhood Design

Locational Context

Urban, suburban

Scale of Application

Plan/Community

Implementation Requirements

The GHG mitigation potential is based, in part, on literature analyzing docked (i.e., station-based) bikeshare programs. This measure should be applied with caution if using dockless (free-floating) bikeshare.

Cost Considerations

The costs incurred by the service manager (e.g., municipality or bikeshare company) may include the capital costs for purchasing an electric bicycle fleet; installing accessible and secure charging stations; storing, maintaining, and replacing the fleet; and marketing and administration. Some of these costs may be offset by income generated through program use. Program participants will benefit from the cost savings from access to cheaper transportation alternatives (compared to private vehicles, private bicycles, or use of ride-hailing services). The local municipality may achieve cost savings through a reduction of cars on the road leading to lower infrastructure and roadway maintenance costs.

Expanded Mitigation Options

Best practice is to discount electric bikeshare membership and dedicate electric bikeshare parking to encourage use of the service. Consider also including space on the vehicle to store personal items while traveling, such as a basket.

GHG Reduction Formula

The quantification methodology does not account for indirect GHG emissions from electricity used to charge the bicycles or direct GHG emissions from vehicle travel of program employees picking up and dropping off bikes.

$$A=\frac{-B\times C\times D\times\left((E\times F)-(G\times H)\right)}{I\times J}$$

GHG Calculation Variables

ID	Parameter	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from vehicle travel in plan/community	0-0.059	%	calculated
User Inputs				
B	Percent of residences in plan/community with access to traditional bikeshare system	0–100	%	user input
C	Percent of bikeshare bikes transitioned to electric bikeshare	0–100	%	user input
Constants, Assumptions, and Available Defaults				
D	Daily bikeshare trips per person	0.021	trips per day per person	MTC 2021
E	Vehicle to electric bikeshare substitution rate	35	%	Fitch et al. 2021
F	Electric bikeshare average one-way trip length	2.1	miles per trip	Fitch et al. 2021
G	Vehicle to conventional bikeshare substitution rate	19.6	%	McQueen et al. 2020
H	Conventional bikeshare average one-way trip length	1.4	miles per trip	Lazarus et al. 2019
I	Daily vehicle trips per person	1.7	trips per day per person	FHWA 2023
J	Regional average one-way vehicle trip length	Table T-10.1	miles per trip	FHWA 2017

Further explanation of key variables:

- (B) – Access to bike sharing is measured as the percentage of residences in the plan/community within 0.25 mile of a bikeshare station. For dockless bikes, users can assume that all residences within 0.25 mile of the designated dockless service area would have access.
- (C) – This is the percentage of bikes within the existing system that are switched from conventional bikeshare bikes to electric bicycles. For example, if a system with 100

conventional bikes retires 50 bikes and replaces them with 50 e-bikes, then this would represent a 50 percent transition. This calculation assumes that a bikeshare transition is not combined with a bikeshare expansion. If it is, the new areas can be estimated using Measure T-22-A, *Implement Pedal (Non-Electric) Bikeshare Program*, Measure T-22-B, *Implement Electric Bikeshare*.

- (D) – An analysis of bikeshare service areas in the San Francisco Bay Area estimated that in locations with access to bikesharing, there were between 21 and 25 bikeshare trips per day per 1,000 residents (MTC 2021). To be conservative, the low end of this range is cited.
- (E) – A study of dockless electric bikeshare in Sacramento found that the substitution rate of vehicles trips by electric bikeshare trips was 35 percent (Fitch et al. 2021).
- (F) – A study of dockless electric bikeshare in Sacramento found that the average one-way bikeshare trip was 2.1 miles (Fitch et al. 2021).
- (G) – A literature review of several academic and government reports found that the average car trip substitution rate by bikeshare trips was 19.6 percent. This included bikeshare programs in Washington D.C., Minneapolis, and Montreal (McQueen et al. 2020).
- (H) – A case study on average trip lengths for pedal and electric bikeshare programs in San Francisco reported a one-way pedal bikeshare trip of 1.4 miles (Lazarus et al. 2019).
- (I) – A summary report of the 2022 National Household Travel Survey (data found that the average person in the United States takes 1.7 vehicle trips per day (FHWA 2023).
- (J) – Ideally, the user will calculate auto trip length for a plan/community at a scale that is appropriate to the geographical area of the electrification efforts. Potential data sources include the metropolitan planning organization travel model, NHTS California Supplement (preferred), or local survey efforts. If the user is not able to provide a plan-specific value using one of these data sources, they have the option to input the existing regional average one-way auto trip length for one of the six most populated core-based statistical areas (CBSA) in California, as presented in Table T-10.1 (FHWA 2017). Trip lengths are likely to be longer for areas not covered by the listed CBSAs, which represent the denser areas of the state.

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) For projects that use default CBSA data from Table T-10.1, the maximum percent reduction in GHG emissions (A) is 0.059 percent. This maximum scenario is presented in the below example quantification.

Subsector Maximum

($\sum A_{max_{T\text{-}18\text{ through }T\text{-}22\text{-}D}} \leq 10\%$) This measure is in the Neighborhood Design subsector. This subcategory includes Measures T-18 through T-22-D. The VMT reduction from the combined implementation of all measures within this subsector is capped at 10 percent.

Example GHG Reduction Quantification

The user is transitioning from a large conventional bikeshare system to an electric bikeshare system. For this example, the project is in the Los Angeles-Long Beach-Anaheim CBSA, and the one-way vehicle trip length would be 9.72 miles (J). If we assume that 100 percent of the residents in the plan/community have bikeshare access (B) and that the fleet is fully transitioning (C), the user would reduce GHG emissions from the plan/community VMT by 0.059 percent.

$$A = \frac{\mathbf{-100\% \times 100\%} \times 0.021 \frac{\text{trips}}{\text{day person}} \times \left(35\% \times 2.1 \frac{\text{miles}}{\text{trip}} - 19.6\% \times 1.4 \frac{\text{miles}}{\text{trip}}\right)}{1.7 \frac{\text{trips}}{\text{day person}} \times 9.72 \frac{\text{miles}}{\text{trip}}} = -0.059\%$$

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 would be the same as the percent reduction in GHG emissions (A). This quantification methodology does not account for the increase in electricity used to charge the vehicles or the fuel consumption from vehicle travel of program employees picking up and dropping off bikes.

VMT Reductions

The percent reduction in VMT would be the same as the percent reduction in GHG emissions (A). This quantification methodology does not account for the miles traveled from vehicle travel of program employees picking up and dropping off bikes.

Sources

- Federal Highway Administration (FHWA). 2017. National Household Travel Survey–2017 Table Designer. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: December 2023.
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- Fitch, D., H. Mohiuddin, and S. Handy. 2021. Examining the Effects of the Sacramento Dockless E-Bike Share on Bicycling and Driving. MDPI: Sustainability. January. Available: https://www.mdpi.com/2071-1050/13/1/368. Accessed: December 2023.
- Lazarus, J., J. Pourquier, F. Feng, H. Hammel, and S. Shaheen. 2019. Bikesharing Evolution and Expansion: Understanding How Docked and Dockless Models Complement and Compete – A Case Study of San Francisco. Paper No. 19-02761. Annual Meeting of the Transportation Research Board: Washington, DC. Available: https://trid.trb.org/view/1572878. Accessed: January 2021.

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- Metropolitan Transportation Commission (MTC). 2021. Technical Methodology to Estimate Greenhouse Gas Emissions for Plan Bay Area 2050. Available: https://www.planbayarea.org/sites/default/files/documents/Technical-Methodology-Memo-to-CARB_final.pdf. Accessed: December 2023.