Preliminary Investigation (PI-0012

Caltrans Division of Research, Innovation and System Information

Quantifying the Results of Key Transit Investments

Requested by
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The Caltrans Division of Research, Innovation and System Information (DRISI) receives and evaluates numerous research problem statements for funding every year. DRISI conducts Preliminary Investigations on these problem statements to better scope and prioritize the proposed research in light of existing credible work on the topics nationally and internationally. Online and print sources for Preliminary Investigations include the National Cooperative Highway Research Program (NCHRP) and other Transportation Research Board (TRB) programs, the American Association of State Highway and Transportation Officials (AASHTO), the research and practices of other transportation agencies, and related academic and industry research. The views and conclusions in cited works, while generally peer reviewed or published by authoritative sources, may not be accepted without qualification by all experts in the field. The contents of this document reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the California Department of Transportation, the State of California, or the Federal Highway Administration. This document does not constitute a standard, specification, or regulation. No part of this publication should be construed as an endorsement for a commercial product, manufacturer, contractor, or consultant. Any trade names or photos of commercial products appearing in this publication are for clarity only.

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Executive Summary

Background

The Caltrans Division of Rail and Mass Transportation (DRMT) administers many state transit programs, including:

- Transit and Intercity Rail Capital Program (TIRCP).
- Low Carbon Transit Operations Program (LCTOP).
- Public Transportation Modernization, Improvement, and Service Enhancement Account (PTMISEA) Program.

The DRMT also administers the mass transportation components of other funding programs. Eligible projects under these funding programs range from new capital investments to operational improvements.

Caltrans would like to know more about the impacts of the types of projects funded through state transit programs on the state of transit in California. To gather this information, CTC & Associates conducted a survey of California transit agencies and conducted a literature search to supplement survey findings.

Summary of Findings

Survey of California Transit Agencies

An online survey of selected California transit agencies representing a range of transit providers (rural, urban, small and large) gathered information about agency practices used to determine the impact of transit investments. Nine transit agencies provided survey responses:

- Alameda-Contra Costa Transit District.
- Fresno County Rural Transit Agency.
- Glenn County.
- Livermore Amador Valley Transit Authority.
- Marin Transit.
- Monterey-Salinas Transit.
- San Diego Metropolitan Transit System.
- Torrance Transit System.
- Yolo County Transportation District.

Survey results are summarized in the topic areas below. Page number references following each topic area indicate where detailed information about the topic is available in the **Detailed Findings** section of this report.

Using Software and Tools (see page 8)

Three respondents use software or another tool that helps justify a request for transit project funding:

- Alameda-Contra Costa Transit District uses Ellipse (an enterprise resource planning solution delivering ridership outcomes), PeopleSoft (software that addresses human capital, financial, supplier and supply chain management) and Prophix (software that offers financial budgeting and forecasting).

- San Diego Metropolitan Transit System recently implemented a SAP Budget and Planning module for managing the annual capital improvement program process. Projects are prioritized and ranked based on established criteria associated with project benefits.
- Torrance Transit System uses Remix, a software program that estimates the cost of launching a new service or route, or modifying an existing service.

Determining Project-Level Impacts (see page 9)

Respondents were asked to describe the methodology used to determine the project-level impact of specific transit investments on nine factors:

Accessibility. When answering this question, survey respondents considered two types of accessibility:

- Accessibility associated with requirements of the Americans with Disabilities Act (ADA).
- Accessibility related to the ability to reach goods, services and activities (coverage of transit services).

Though compliance with ADA is a consideration, most respondents described accessibility in terms of service coverage. Their practices include reviewing stop-level accessibility, tracking ridership, surveying customers, and tracking the percentage of residents, major employers and schools within one-quarter mile of a transit stop.

Costs. Practices include tracking budgets and changes in operating costs, considering the quality and estimated life of an asset, and meeting cost-efficiency standards based on cost per revenue hour.

Greenhouse gas emissions. Most respondents cited the greenhouse gas (GHG) reporting requirements associated with the LCTOP program and the California Air Resources Board calculator tool used to satisfy those requirements.

Land use. We found no consensus with regard to respondents' assessment of the land use impacts of transit investments. Some respondents indicated that land use impacts are not considered, while other transit agencies consider land use when selecting project locations.

Mobility. Assessment practices include placing projects at existing pedestrian facilities, monitoring changes in ridership and tracking passenger trips.

Safety. Respondents track accident reports and problem road calls; survey locations for safety in terms of traffic level, lighting and other factors; and measure and report on key performance indicators (KPIs) such as preventable accidents.

Service quality. Agencies monitor customer feedback through the use of surveys and complaint statistics to determine rider satisfaction, analyze statistics to assess a project's ability to offer more services and provide on-time performance, and measure and report on KPIs such as mean distance between failures and on-time performance.

Torrance Transit System uses the agency's automatic vehicle locator (AVL) system to determine service quality and efficiency. (The agency's AVL system provides ADA-compliant

displays and announcements, and is used to collect data for scheduling and service planning.)

Transit ridership. Respondents reported tracking boardings and ridership by route program and system. Stop-level ridership is assessed using automatic passenger counters, on-off direct surveys and video surveys with on-board cameras.

Travel time. Respondents track travel time but provided few specifics as to how tracking is conducted. One agency monitors scheduled times versus equivalent auto travel times, while another uses AVL system data to study travel time and patterns.

The Marin Transit respondent noted that examining project-level impacts can be difficult and is not always warranted, logical or possible.

Using Data to Assess Investments (see page 20)

Most agencies use ridership data to assess project-level investments. Passenger miles traveled, maintenance expenditures, downtime, rides per hour, and vehicle revenue hours and miles are also used.

There was little consensus among respondents with regard to the methods used to gather data. The most frequently cited method—the use of in-person or video surveys—was reported by more than half of the respondents. Agencies also use contractor reports, automatic passenger counters, databases and software, field observations, fuel usage and public meetings.

Most respondents gather project-related data multiple times a year. Four respondents gather data monthly, quarterly and annually. Some agencies gather data at unspecified times of the year and are guided by the reporting requirements of individual projects.

Using Reporting to Track Investments (see page 23)

Financial and operational reports were the most commonly reported types of reports produced to track project investments. Other types of reporting present data generated by an agency's AVL system or the National Transit Database. (The Federal Transit Administration's National Transit Database includes information about inventories of vehicles and maintenance facilities, safety event reports, measures of transit service provided and consumed, and data on transit employees.)

Quantifying the Results of Project-Level Investments (see page 25)

Two respondents reported specific practices to quantify the results of project-level investments:

- When purchasing newer, heavier duty vehicles, Glenn County evaluates maintenance costs associated with the old and new vehicles. The transit agency has also collected subjective data on passenger satisfaction.
- Yolo County Transportation District conducts on-board, in-person on-off surveys and video surveys to gather data to quantify investments.

Linking Investments to Outcomes (see page 25)

None of the agencies described systematic efforts to link investments to outcomes, reporting instead on more general expectations for outcomes. Respondents' expectations for outcomes from specific transit investments include:

- Lower maintenance costs and greater longevity for vehicles, as well as higher ridership (Glenn County).
- Increased ridership and improved customer experience (Livermore Amador Valley Transit Authority).
- Increased mobility and congestion relief (Marin Transit).
- Reduced travel time (Monterey-Salinas Transit).
- Reduced GHG emissions through increased transit ridership (San Diego Metropolitan Transit System).
- Improved connectivity for public transportation services (Torrance Transit System).

Related Resources

A literature search identified resources (beginning on page 26 of this report) that may inform the development of a framework to assess transit project investments. A few resources that examine benefits from a broader perspective may be transferable to a targeted review of project-level impacts. Each resource includes a link to the publication and a brief summary of its content.

Evaluation Methods and Tools (see page 26)

A research project in progress is developing guidance for calculating a return on investment for rehabilitating or replacing existing transit assets to help achieve state of good repair. Published guidance includes a guidebook that describes how to create a comprehensive framework for evaluating the full impacts (benefits and costs) of a particular transit service or improvement, and a 2017 Transit Cooperative Research Program (TCRP) report that identifies practices for evaluating the economic impacts and benefits of transit. (The latter document considers benefits from a broader perspective than a project-by-project assessment.)

Metrics and methods to assess and compare the environmental performance of major transit investments are presented in a 2012 TCRP report. A 2015 TCRP report develops "a methodology to quantify the transportation-related GHG emissions and energy use related to land use changes that can be attributed to transit."

Other Publications (see page 28)

A 2015 journal article discusses how to assess the sustainability of a transit investment, with the authors noting that "transit can both reduce congestion and improve air quality, but the magnitudes of these benefits are uncertain and may be specific to each location." A 2014 journal article reviews calculators used to estimate GHG emissions. The article's authors note that no single calculator contains all the information needed by transit agencies for a comprehensive evaluation of emissions.

Two research reports examine the impacts of bus rapid transit on land use patterns and property values. Ridership is examined in reports that address the factors that influence transit

use and the effectiveness of transit-oriented development to increase ridership. Finally, a TCRP research project in process is examining the relationship between transit asset condition and service quality.

Gaps in Findings

The survey received a limited response, and some respondents provided few details of agency practices or indicated that assessments are made at the program—not project—level. A few respondents do not appear to engage in a robust, comprehensive project-level assessment of transit investments. Other California transit agencies may conduct project-by-project assessments of transit investments; additional outreach could attempt to identify these agencies.

Program-level analyses, while not examined in detail in this report, may offer guidance when developing a framework for project-level assessment of transit investments.

Next Steps

Moving forward, Caltrans could consider:

- Investigating the software and other tools used by respondents, including:
    - Ellipse, PeopleSoft and Prophix (Alameda-Contra Costa Transit District).
    - SAP Budget and Planning module (San Diego Metropolitan Transit System).
    - Remix and AVL system (Torrance Transit System).
- Examining in detail the types of data gathered and reporting produced by respondents.
- Reviewing the methods and tools used to assess transit investments from a broader perspective to identify practices that might be applicable to project-level assessment.
- Following up on the research projects in progress to determine if project findings will inform Caltrans' examination of project-level assessment.

Detailed Findings

Survey of California Transit Agencies

Survey Approach

Selected California transit agencies representing a wide range of transit providers (rural, urban, small and large) received a survey about the agency practices used to determine the impact of transit investments. The survey included the following questions:

1. Does your agency use software or another tool to determine the justification when requesting funding for a project?
    - No.
    - Yes (please describe the software or tool).
2. Once projects are funded, please describe the methodology used by your agency to determine the project-level impact of specific transit investments on the following factors:
    - Accessibility.
    - Costs.
    - Greenhouse gas emissions.
    - Land use.
    - Mobility.
    - Safety.
    - Service quality.
    - Transit ridership.
    - Travel time.

2A. Please describe any other factors not listed above and the methodology used to determine the project-level impact of specific transit investments.

3. Please describe the project-related data your agency gathers to assess the impact of a project investment.
4. How does your agency gather this data?
5. When does your agency gather this data? (Select all that apply.)
    - Monthly.
    - Quarterly.
    - Semiannually.
    - Annually.
    - Every two years.
    - Every three years.
    - Other (please specify).
6. Has your agency quantified project-level investments?
    - No.
    - Yes (please describe your agency's quantification practices).
7. Is your agency actively seeking to link a specific transit investment to a specific outcome?
8. Please describe the type of reporting your agency produces to track project investments.
9. If available, please provide links to sample reports and other documentation related to your agency's analysis of transit investment impacts.

Summary of Survey Results

Nine California transit agencies responded to the survey:

- Alameda-Contra Costa Transit District.
- Fresno County Rural Transit Agency.
- Glenn County.
- Livermore Amador Valley Transit Authority.
- Marin Transit.
- Monterey-Salinas Transit.
- San Diego Metropolitan Transit System.
- Torrance Transit System.
- Yolo County Transportation District.

Appendix A provides the full text of all survey responses.

The following summarizes survey responses in six topic areas:

- Using software and tools.
- Determining project-level impacts.
- Using data to assess investments.
- Using reporting to track investments.
- Quantifying the results of project-level investments.
- Linking investments to outcomes.

Using Software and Tools

Three respondents use software or another tool to help the agencies justify requests for transit project funds:

- Alameda-Contra Costa Transit District uses Ellipse, PeopleSoft and Prophix.
- San Diego Metropolitan Transit System recently implemented a SAP Budget and Planning module for managing the annual capital improvement program process. Projects are prioritized and ranked based on established criteria regarding project benefits.
- Torrance Transit System uses Remix, a software program that estimates the cost of launching a new service or route, or modifying an existing service.

Related Resources:

ABB Ability Ellipse Enterprise Asset Management, ABB, 2018.
http://new.abb.com/enterprise-software/asset-optimization-management/ellipse-eam
This web site describes Ellipse as "the premier connected asset lifecycle management solution that unifies world-class functionality of enterprise asset management (EAM), workforce management (WFM) and asset performance management (APM)."

Oracle PeopleSoft Applications, Oracle, 2017.
http://www.oracle.com/us/products/applications/peoplesoft-enterprise/overview/index.html
These software applications address human capital, financial, supplier and supply chain management, as well as enterprise services automation.

Prophix, Prophix Software Inc., undated.
http://www.prophix.com/solutions/budgeting-planning/
This corporate performance management software offers financial budgeting, forecasting and reporting features.

Remix, undated.
https://www.remix.com/
This planning platform for public transit allows users to design routes in any city and immediately understand the cost and demographic impact of a proposed change.

Related Resource:

> **"Taking the Heartache Out of Planning in Torrance, CA,"** Matt Fleck, *Remix Blog Post*, September 2016.
> https://blog.remix.com/taking-the-heartache-out-of-planning-in-torrance-ca-9de28a01e89f
> *From the blog post*: With so few transit planners on the team, Torrance Transit never had enough time to proactively plan route scenarios. In the past, it would've taken 2 months to work out each individual scenario. With Remix, now it takes 3 days.
>
> By the numbers:
>
> - Planning new scenarios dropped from 2 months to 3 days.
> - $550k saved in operating costs by cutting redundancy, invested in weekend service as a result.
> - Time spent iterating on existing routes fell from 1 week to 10 minutes.

User Guide: SAP Budgeting and Planning for Public Sector, Document Version 1.0, SAP, July 2017.
https://help.sap.com/doc/367477e6c8b94385bcd6404f06bc4c86/1.0.0.3/en-US/SBP_10FP03_Application_Help.pdf
This user guide describes the SAP product used by San Diego Metropolitan Transit System.

Determining Project-Level Impacts

Respondents were asked to describe the methodology used to determine the project-level impact of specific transit investments on the following factors: accessibility, costs, greenhouse gas (GHG) emissions, land use, mobility, safety, service quality, transit ridership and travel time.

Survey responses indicated a wide range of practices, with little consensus among agency approaches. In some cases, an agency assessment is conducted at the organization level, not on a project-by-project basis. Survey responses are summarized below.

Note: Respondents considered two types of accessibility when addressing project-level impacts:

- Accessibility associated with requirements of the Americans with Disabilities Act (ADA).
- Accessibility related to the ability to reach goods, services and activities (coverage of transit services).

The table below reflects both types of practices.

Accessibility		
Transit Agency	**Focus of Practice**	**Agency Practice**
Alameda-Contra Costa Transit District	ADA	Meets ADA requirements.
Fresno County Rural Transit Agency	N/A	Doesn't have any projects that address accessibility.
Glenn County	ADA	Ensures all vehicle purchases are ADA-compliant. Employs no methodology but does evaluate rider feedback during the unmet needs process and monitors boarding and alighting statistics. Typically, the agency considers the impact associated with ADA requirements during project development, not after the project has been funded. Projects that have already satisfied ADA requirements or for which an exemption is viable get funded or moved to the front of the project queue because they tend to cost less. Projects with multiple ADA benefits that extend beyond the project itself are first in line for development, followed by those that achieve only project-specific benefits.
Livermore Amador Valley Transit Authority	Service coverage	Evaluates the difference in total number of riders served before and after the project.
Marin Transit[1]	Service coverage	1. Tracks the percentage of residents, major employers and schools within one-quarter mile of a transit stop. 2. Maintains a bus stop inventory to permit a review of stop-level accessibility. (The respondent noted that "[c]apital projects to improve bus stops make a small impact systemwide, but only by addressing each individual stop do we improve the system.")
Monterey-Salinas Transit	Service coverage	Uses feedback from the agency's Mobility Access Committee. Other activities and practices include:

Accessibility		
Transit Agency	**Focus of Practice**	**Agency Practice**
		• Conducting a passenger survey every two years to gather feedback on service coverage. • Using boarding counts for capital projects such as a bus shelter. • Reviewing ridership and boarding data for operational projects such as a new transit route to determine where the most passengers are accessing the service along the route. On-time performance might also be reviewed.
San Diego Metropolitan Transit System[2]	Service coverage	Tracks and reports impacts on ridership at specific locations when required by specific funding agreements. An example: The agency was recently awarded a $39 million Transit and Intercity Rail Capital Program (TIRCP) grant to construct a new terminal station at the downtown courthouse and procure nine new light rail vehicles to run more frequent service. The transit agency's planning department will be responsible for submitting required reporting on ridership changes attributed to the project in accordance with TIRCP guidelines. The agency does not specifically measure the project-level impact of investments in terms of ADA-related accessibility, though all construction projects are performed in accordance with current ADA regulation. Projects addressing a need or an opportunity for improving access are typically funded. For example, the agency recently funded an ongoing project that expands the concrete pads at several bus stops to better accommodate wheelchair access. In this example, the agency identified a need and addressed it, but does not conduct a formal analysis of the project's impact on ADA accessibility.
Torrance Transit System	ADA Service coverage	Surveys bus stop locations to determine ADA accessibility and the installation of amenities. The agency ensures all work performed is ADA-compliant. A **stop-level database** assesses the accessibility level of each of the agency's 800 stops. This assessment examines both ADA compliance and coverage of transit services (for example, distance between stops and proximity to disadvantaged communities). All buses are equipped with **automatic passenger counters** that can determine at the stop level the number of boardings and alightings at each stop. This data-gathering tool aids agency efforts to determine stop productivity (before and after any type of work performed at the stop)

Accessibility		
Transit Agency	**Focus of Practice**	**Agency Practice**
		and assess its level of accessibility. Bus operators are trained to **call in the pickup** of a patron who requires the use of a mobility device (such as a wheelchair) or deployment of a bicycle rack for multimodal and first/last mile travelers. This practice allows the agency to determine the frequency of these needs at each stop.
Yolo County Transportation District	Not known	Applies an unspecified internal agency analysis.

1 The Marin Transit respondent cited the agency's Short Range Transit Plan as providing guidance for its analysis of many of the project-level impacts examined in the survey.

2 Typically, San Diego Metropolitan Transit System does not track project-level impacts unless required to do so by a specific funding agreement. Most large-scale projects are managed by San Diego Association of Governments on behalf of the transit agency. Small projects, such as shelter rehabilitations, rolling stock procurements, software purchases and maintenance center rehabilitation, are managed by San Diego Metropolitan Transit System. The impacts of these projects are negligible when compared to large-scale construction projects or capital investments related to an expansion of service.

Costs	
Transit Agency	**Agency Practice**
Alameda-Contra Costa Transit District	Tracks budget, scope and delivery schedule to minimize costs.
Fresno County Rural Transit Agency	Tracks through generally accepted accounting methods; no other software or tools are used.[1]
Glenn County	Considers the quality of the purchase and the estimated life of the asset.
Livermore Amador Valley Transit Authority	N/A
Marin Transit	Meets cost-efficiency standards based on cost per revenue hour.
Monterey-Salinas Transit	Reviews project expenses monthly or quarterly.
San Diego Metropolitan Transit System	• Uses SAP Enterprise Resource Planning (ERP) software for all accounting functions, including tracking of capital budget and expenditures. • Tracks changes in operating costs; does not typically track changes directly attributed to capital investments.
Torrance Transit System	Factors the average cost of stop maintenance and upkeep into the project.

Costs	
Transit Agency	**Agency Practice**
Yolo County Transportation District	Conducts unspecified cost analyses on a case-by-case basis.

1 The respondent also stated that in a typical grant project, the agency is not asked to determine if the project results in any savings or if it impacts the overall costs associated with the agency's transit operation. Both would be difficult for the agency to estimate. Sometimes certain grant projects are presumed (by the funder and the agency) to have a positive impact on transit operating costs simply by the nature of the grant project in question.

Note: Most respondents reported using a California Air Resources Board (CARB) calculator tool to assess the project-level impact of transit investments on GHG emissions. Respondents use CARB's calculator tool to complete a portion of the semiannual reporting required for projects funded under the Low Carbon Transit Operations Program (LCTOP). See **Related Resources** on page 14 for more information about the quantification methodologies and calculator tools used by respondents to estimate project-level GHG emissions.

Greenhouse Gas Emissions	
Transit Agency	**Agency Practice**
Alameda-Contra Costa Transit District	Tracks GHG emissions for zero-emissions buses and diesel fleets.
Fresno County Rural Transit Agency	Determines the emissions benefit during grant writing (before funding) if the project involves emissions calculations or explicitly addresses GHG emissions; little if any reporting is done after funding. An exception: The agency uses the CARB calculator tool provided to meet LCTOP semiannual reporting requirements.
Glenn County	Uses the CARB calculator tool provided to meet LCTOP semiannual reporting requirements. Uses the California Emissions Estimator Model rarely. This tool is more typically used to estimate emissions associated with land use and development. Local air district personnel use engine size or type to provide guidance on vehicle purchases that would assist in lowering GHG emissions.
Livermore Amador Valley Transit Authority	Uses the CARB calculator tool provided to meet LCTOP semiannual reporting requirements.
Marin Transit	Uses the CARB calculator tool provided to meet LCTOP semiannual reporting requirements.

Greenhouse Gas Emissions	
Transit Agency	**Agency Practice**
Monterey-Salinas Transit	Uses the CARB calculator tool provided to meet LCTOP semiannual reporting requirements.
San Diego Metropolitan Transit System	Doesn't monitor GHG emissions unless required by specific grant programs. For example, LCTOP and TIRCP require GHG emissions reduction analysis and reporting at the project level. The agency uses a calculator tool developed by CARB in connection with TIRCP that uses key inputs such as the change in ridership due to the project and the fuel type of new versus displaced vehicles to assess reductions in GHG emissions. (The respondent noted that the agency uses a wide range of metrics for monitoring the system as a whole, but, generally, the agency does not measure specific impacts of internal capital projects due to the nature of those projects.)
Torrance Transit System	Tracks and reports annual reductions in GHG emissions. (The agency maintains a 100% alternative-fuel bus fleet.) Typical tracking involves service miles, hours and the amount of fuel consumed on an annual basis. Service-related and fuel consumption data are reported to the National Transit Database. Internally, this data is used to gauge vehicle fuel efficiency based on mile per gallon (gas gallon equivalent), which is then used to calculate reductions in NOx and GHG.
Yolo County Transportation District	Uses the CARB calculator tool provided to meet LCTOP semiannual reporting requirements.

Related Resources:

Cap-and-Trade Auction Proceeds Quantification Materials, California Air Resources Board, March 2018.
https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm
This web site provides links to draft and archived versions of the quantification methodology and calculator tool that transit agencies are required to use when submitting the semiannual reporting required by LCTOP. *From the web site*:

> The table below provides links to CARB quantification methodologies and calculator tools developed in consultation with administering agencies through a public process. CARB staff periodically update[s] methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified.

Quantification Methodology for the California Department of Transportation Low Carbon Transit Operations Program, Greenhouse Gas Reduction Fund, Fiscal Year 2017-18, California Air Resources Board, January 2018.
https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/caltrans_lctop_finalqm_17-18.pdf
This document describes the methodology used to evaluate pollutant emissions reductions from transportation projects competing for LCTOP funding.

Related Resources:

Low Carbon Transit Operation Program Semi-Annual Report, Low Carbon Transit Operations Program (LCTOP), Caltrans Division of Rail and Mass Transportation, July 2017.
http://www.dot.ca.gov/drmt/docs/lctop/lctopsemiannrpt.docx
The Project Benefits and Results portion of this LCTOP semiannual report (page 2 of the report) requires an estimate of GHG reduction identified using the ARB Quantification Methodology Tool. The same tool (see the citation below) is used to estimate GHG emission reductions for projects proposed for funding.

Calculator Tool for the California Department of Transportation Low Carbon Transit Operations Program, Greenhouse Gas Reduction Fund, Fiscal Year 2017-18, California Air Resources Board, undated.
https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/caltrans_lctop_finalcalculator_17-18.xlsx
This calculator tool is required by LCTOP for use with fiscal year 2017-2018 reporting.
From the introduction to the tool:

> Applicants must use this calculator to estimate the GHG emission reductions and air pollutant emissions associated with the proposed LCTOP projects as defined in the LCTOP Allocation Request form. This Excel file must be submitted with other documentation requirements.

Quantification Methodology for the California State Transportation Agency Transit and Intercity Rail Capital Program, Greenhouse Gas Reduction Fund, Fiscal Year 2018-19, California Air Resources Board, October 2017.
https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/calsta_tircp_finalqm_18-19.pdf
This document describes the methodology used to evaluate pollutant emissions reductions from transportation projects competing for TIRCP funding.

Related Resource:

Calculator Tool for the California State Transportation Agency Transit and Intercity Rail Capital Program, Greenhouse Gas Reduction Fund, Fiscal Year 2018-19, California Air Resources Board, undated.
https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/calsta_tircp_finalcalculator_18-19.xlsm
This calculator tool accompanies the quantification methodology for TIRCP cited above.

Comprehensive Map to Support the Disadvantaged and Low-Income Communities Investment Guidelines, California Air Resources Board, undated.
https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/lowincomemapfull.htm
This compilation of individual maps can be used to apply the geographic criteria from the funding guidelines associated with Senate Bill 535 (De León, Chapter 830, Statutes of 2012), which directs state and local agencies to make significant investments that improve California's most vulnerable communities. This map shows the following areas:

- Census tracts that have been identified by California Environmental Protection Agency as disadvantaged communities.
- Half-mile zones around these disadvantaged community census tracts (applicable to some projects in the low carbon transportation, transit, affordable housing and sustainable communities, land preservation and restoration, and urban forestry and urban greening categories).
- ZIP codes containing disadvantaged community census tracts (applicable to some projects in low carbon transportation and transit categories).

California Emissions Estimator Model, California Air Pollution Control Officers Association, 2017.
http://www.caleemod.com/
From the web site: The **Cal**ifornia **E**missions **E**stimator **Mod**el (CalEEMod) is a statewide land use emissions computer model designed to provide a uniform platform for government agencies, land use planners and environmental professionals to quantify potential criteria pollutant and greenhouse gas (GHG) emissions associated with both construction and operations from a variety of land use projects.

Land Use[1]	
Transit Agency	**Agency Practice**
Glenn County	Considers geographical dispersion and area compatibility when deciding on transit project locations.
Monterey-Salinas Transit	Communicates with local municipalities to assess land use impacts.
Torrance Transit System	Evaluates land use to determine the best use of service and capital before project launch.
Yolo County Transportation District	Determines land use impact on a case-by-case basis.

1 Alameda-Contra Costa Transit District, Fresno County Rural Transit Agency, Livermore Amador Valley Transit Authority, Marin Transit and San Diego Metropolitan Transit System do not consider land use impacts.

Mobility	
Transit Agency	**Agency Practice**
Alameda-Contra Costa Transit District	Doesn't track mobility impacts other than ridership.
Fresno County Rural Transit Agency	Considers all projects involving the expansion of the transit fleet to increase mobility in the service area and/or the local region.
Glenn County	Places projects at existing pedestrian facilities when possible.
Livermore Amador Valley Transit Authority	Monitors change in ridership and boardings.
Marin Transit	• Tracks total ridership on a monthly, quarterly and annually. • Tracks passenger trips for a project (route and service) if warranted.
Monterey-Salinas Transit	Uses feedback from the agency's Mobility Access Committee.
San Diego Metropolitan Transit System	Tracks and reports impacts on ridership at specific locations when required by specific funding agreements.
Torrance Transit System	Analyzes survey data on bus services to determine the effectiveness of mobility and service connections.
Yolo County Transportation District	Determines impact on a case-by-case basis.

Safety	
Transit Agency	**Agency Practice**
Alameda-Contra Costa Transit District	Uses unspecified detailed tracking and reporting.
Fresno County Rural Transit Agency	Selects projects to address internally identified safety issues in the transit system.[1]
Glenn County	Places projects to allow safe entry and departure of vehicles and passengers.
Livermore Amador Valley Transit Authority	Implements unspecified new safety and security measures.
Marin Transit	Tracks accident reports and problem road calls.
Monterey-Salinas Transit	Reviews safety issues (the agency's risk and security manager).
San Diego Metropolitan Transit System	Measures and reports key performance indicators (KPIs) related to safety such as preventable accidents. KPIs are

Safety	
Transit Agency	**Agency Practice**
	measured at the organization level.
Torrance Transit System	Surveys all locations for patron and operator safety in terms of traffic level, lighting and other factors.
Yolo County Transportation District	Determines impact on a case-by-case basis.

1 The respondent also noted that many agency grant projects are undertaken with the aim of addressing specific safety issues or problems identified by agency staff, with the safety equipment or program specified in the grant project serving as the remedy. An example is the installation of security gates and security cameras acquired through a grant project to enhance the safety of bus storage areas.

Service Quality	
Transit Agency	**Agency Practice**
Alameda-Contra Costa Transit District	Uses unspecified detailed tracking and reporting.
Fresno County Rural Transit Agency	• Analyzes agency statistics to assess a project's ability to offer more services and provide on-time performance. • Uses passenger surveys and complaint statistics to determine rider satisfaction with service quality.
Glenn County	Monitors current passenger interactions with facilities and vehicles, driver observations and ridership.
Livermore Amador Valley Transit Authority	Uses unspecified standard service quality metrics provided in the agency's operations and maintenance contract.
Marin Transit	Completes routine passenger surveys.
Monterey-Salinas Transit	Monitors customer feedback.
San Diego Metropolitan Transit System	Measures and reports on KPIs related to service quality such as mean distance between failures, on-time performance and number of complaints (organization-level impacts).
Torrance Transit System	• Conducts routine passenger surveys. • Analyzes the agency's automatic vehicle locator (AVL) system[1] data to determine service quality and efficiency.
Yolo County Transportation District	Determines impact on a case-by-case basis.

1 A recent online magazine article, available at http://www.metro-magazine.com/management-operations/news/722323/apta-question-of-the-day-the-impact-of-new-tech, describes Torrance Transit System's AVL system, which "improves the customer experience by providing ADA-compliant displays and announcements." The agency also uses the system to collect data for scheduling and service planning.

Transit Ridership	
Transit Agency	**Agency Practice**
Alameda-Contra Costa Transit District	Uses unspecified detailed tracking and reporting.
Fresno County Rural Transit Agency	Analyzes agency statistics to determine ridership impact, either systemwide or specific to the grant project.
Glenn County	Gives consideration to previous efforts and requests during the unmet needs process.
Livermore Amador Valley Transit Authority	Tracks boardings data.
Marin Transit	• Tracks ridership by route, program and system and reports to the board monthly. • Monitors stop-level ridership using a 100% ridecheck and automatic passenger counters. (Ridecheck is "a comprehensive survey of all local bus routes, trips and stops" that "provides the agency with a detailed picture of local transit ridership.")
Monterey-Salinas Transit	Tracks ridership on a monthly basis.
San Diego Metropolitan Transit System	Tracks and reports ridership at specific locations affected by the project, when required.
Torrance Transit System	Assesses the number of boardings, ridership and alightings at all locations through the agency's AVL system and automatic passenger counters.
Yolo County Transportation District	• Determines impact on a case-by-case basis. • Assesses ridership using on-off direct surveys or video surveys with on-board camera systems.

Travel Time	
Transit Agency	**Agency Practice**
Alameda-Contra Costa Transit District	Uses unspecified detailed tracking and reporting.
Fresno County Rural Transit Agency	Analyzes agency statistics to determine systemwide impact or impacts specific to the grant project.
Glenn County	Places facilities and amenities at strategic locations to maximize efficiencies due to headway times. (Federal Transit Administration defines "headway" as "the time interval between vehicles moving in the same direction

Travel Time	
Transit Agency	**Agency Practice**
	on a particular route"; see https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary.)
Livermore Amador Valley Transit Authority	Conducts corridor-specific analyses as needed.
Marin Transit	• Provides competitive travel times to promote transit usage. • Monitors scheduled times versus equivalent auto travel times.
Monterey-Salinas Transit	Monitors monthly on-time performance.
San Diego Metropolitan Transit System	Measures on-time performance for different service types, but not at the project level.
Torrance Transit System	Analyzes AVL system data to study travel time and patterns.
Yolo County Transportation District	Determines impact on a case-by-case basis.

Other Factors and Approaches to Project Assessment

Respondents identified other factors used to assess project investments and offered more information about their agencies' general approach to project assessment:

- Fresno County Rural Transit Agency considers societal factors when determining the location of a project or the service area of a grant project. These efforts are prompted by the recent emphasis by grant funders on disadvantaged communities and environmental justice-related issues in their grant projects.
- Glenn County tracks the effects on its existing fleet and the reduction in maintenance costs. While the agency also does not formally evaluate individual projects, it does closely monitor performance metrics, and the respondent noted that "it is generally evident there is impact of investment on the service."
- Marin Transit monitors and tracks performance on a system level through its Short Range Transit Plan and generally selects projects that meet system objectives. The respondent noted that examining project-level impacts can be difficult and is not always warranted, logical or possible.

Using Data to Assess Investments

Type of Data

Respondents were asked to describe the project-related data that is gathered to assess the impact of a project investment. The table below summarizes survey responses.

Project-Level Data Used to Assess Investments								
Transit Agency	**Downtime**	**Maintenance Expenditures**	**Passenger Miles Traveled**	**Ridership**	**Rides Per Hour**	**Vehicle Revenue Hours**	**Vehicle Revenue Miles**	**No Response**
Alameda-Contra Costa Transit District								X
Fresno County Rural Transit Agency				X				
Glenn County	X	X		X				
Livermore Amador Valley Transit Authority								X
Marin Transit[1]								
Monterey-Salinas Transit			X	X		X	X	
San Diego Metropolitan Transit System				X				
Torrance Transit System			X					
Yolo County Transportation District				X	X			

1 The Marin Transit respondent noted that the data gathered is highly dependent on the project type. Monitoring on a systemwide basis tends to be more relevant than identifying the projects that help create systemwide improvements. The respondent also cautioned that too much focus on results from small project grants may not be productive.

Data-Gathering Methods

There was little consensus among respondents with regard to the methods used to gather data. The most frequently cited method—the use of in-person or video surveys—was reported by more than half of the respondents.

Data-Gathering Methods											
Transit Agency	**Automatic Passenger Counters**	**Contractor Reports**	**Databases and Software**	**Farebox Data Collection**	**Field Observations**	**Fuel Usage**	**Hours in Operation**	**Public Meetings**	**Scheduling Software**	**Surveys (In-Person and Video)**	**No Response**
Alameda-Contra Costa Transit District											X
Fresno County Rural Transit Agency		X	X[1]								
Glenn County	X			X	X	X				X	

Data-Gathering Methods											
Transit Agency	Automatic Passenger Counters	Contractor Reports	Databases and Software	Farebox Data Collection	Field Observations	Fuel Usage	Hours in Operation	Public Meetings	Scheduling Software	Surveys (In-Person and Video)	No Response
Livermore Amador Valley Transit Authority	X		X[2]							X	
Marin Transit	X	X		X						X	
Monterey-Salinas Transit				X	X				X		
San Diego Metropolitan Transit System			X[3]								
Torrance Transit System								X		X	
Yolo County Transportation District										X	

1 The agency uses data from agency databases and spreadsheets.

2 The agency uses data from the National Transit Database.

3 The agency uses data from ridership tracking software and its SAP ERP software.

Related Resource:

The National Transit Database, Federal Transit Administration, 2017.
https://www.transit.dot.gov/ntd
This web site provides a link to the National Transit Database (NTD) and related resources.
From the web site:

> The NTD is designed to support local, state and regional planning efforts and help governments and other decision-makers make multi-year comparisons and perform trend analyses. It contains a wealth of information such as agency funding sources, inventories of vehicles and maintenance facilities, safety event reports, measures of transit service provided and consumed, and data on transit employees.

Frequency of Gathering Project-Related Data

Most respondents gather project-related data multiple times a year. The table below summarizes responses.

Frequency of Gathering Project-Related Data

Transit Agency	Never	As Needed	Monthly	Quarterly	Semiannually	Annually	Every Two Years	Every Three Years	No Response
Alameda-Contra Costa Transit District									X
Fresno County Rural Transit Agency[1]			X	X	X	X	X	X	
Glenn County			X	X		X			
Livermore Amador Valley Transit Authority	X								
Marin Transit			X	X		X	X		
Monterey-Salinas Transit			X	X	X	X		X	
San Diego Metropolitan Transit System		X							
Torrance Transit System[2]				X		X		X	
Yolo County Transportation District								X[3]	

1 The agency gathers data at various times, depending on the reporting requirements of each grant project, grant funder or other applicable requirements.

2 The agency gathers data at various times, depending on the type of report or information being gathered.

3 Project-level analyses are completed every three years.

Using Reporting to Track Investments

Respondents were asked to identify the type of reporting their agencies produce to track project investments. Financial and operational reports were the most commonly reported among the respondents:

Financial Reports

- Marin Transit produces an annual budget, quarterly financial reports and its Comprehensive Annual Financial Report.
- Monterey-Salinas Transit uses Microsoft Dynamics NAV 2009 R2 and Microsoft Dynamics NAV 2009 R2 Classic with Microsoft SQL Server accounting software to produce financial reports in the formats required by Caltrans. This program can report on actual expenses and encumbrances for grants and also produces asset inventory reports.
- San Diego Metropolitan Transit System produces capital expenditure and benefit reports as required by each program.

Operational Reports

- Fresno County Rural Transit Agency produces operational reports that include project narratives and data that address updates on project tasks, accomplishments, and transit operational data such as ridership or a listing of the transit equipment or vehicles acquired.
- Glenn County produces reports that examine program indicators on costs and ridership performance relative to the investment.

Other types of reporting generated or used by respondents include:

- Data from the agency's AVL system (Torrance Transit System).
- NTD reporting (Torrance Transit System and Yolo County Transportation District).
- Short Range Transit Plan (Marin Transit).

Related Resources:

Comprehensive Annual Financial Report, For the Years Ended June 30, 2017 and 2016, Marin County Transit District, November 2017.
https://marintransit.org/sites/default/files/inline-files/Marin%20Transit%202017%20CAFR.pdf
This is Marin Transit's most recent annual financial report.

2018-2027 Short Range Transit Plan, Marin Transit, December 2017.
https://marintransit.org/sites/default/files/projects/2018/2018-2027%20SRTP%20FINAL%202017-DEC.pdf
From the executive summary: An up-to-date Short Range Transit Plan (SRTP) guides Marin Transit's investments in the future. It is a living document that uses current information, financial resources, and performance targets to plan for local public transit services. The SRTP balances Marin Transit's projected costs and revenues over a five-year timeframe, and is designed to provide a ten-year vision of the future.

Microsoft Dynamics NAV 2009 R2, Microsoft, 2018.
https://msdn.microsoft.com/en-us/library/mt842525.aspx
This web site provides links to information about the NAV product, including new features and application and developer updates. Monterey-Salinas Transit uses Microsoft Dynamics NAV 2009 R2 to produce financial reports.

"Public Transit GM Q&A: What Has Been the Impact of New Technology?" *Metro Magazine*, May 2017.
http://www.metro-magazine.com/management-operations/news/722323/apta-question-of-the-day-the-impact-of-new-tech
This online magazine article includes the following from Torrance Transit System's transit director:

> In April of this year, we implemented our Automatic Vehicle Locator system that provides real-time bus arrival information on mobile devices via mobile applications and text messaging. The technology improves the customer experience by providing ADA-compliant displays and announcements. The system also aids us with data collection for scheduling/service planning, increases passenger-operator safety, promotes efficiency and decreases operational costs.

Quantifying the Results of Project-Level Investments

Two respondents reported specific practices to quantify the results of project-level investments:

- When purchasing newer, heavier duty vehicles, Glenn County evaluates maintenance costs associated with the old and new vehicles. The transit agency has also collected subjective data on passenger satisfaction.
- Yolo County Transportation District conducts on-board, in-person on-off surveys and video surveys to gather data to quantify investments.

Respondents from San Diego Metropolitan Transit System and Torrance Transit System noted that their agencies track impacts or review project-level investments but did not describe quantification practices. Respondents from Livermore Amador Valley Transit Authority and Monterey-Salinas Transit reported that their agencies do not quantify the results of project-level investments.

Linking Investments to Outcomes

None of the agencies described systematic efforts to link investments to outcomes, reporting instead on more general expectations for outcomes. The following describes respondents' expectations for outcomes from specific transit investments:

- *Glenn County*. Generally, the agency expects project funding to provide lower maintenance costs and greater longevity for vehicles, as well as higher ridership.
- *Livermore Amador Valley Transit Authority*. Most agency investments aim to increase ridership and improve the customer experience.
- *Marin Transit*. The agency strives to associate its transit projects with increased mobility and congestion relief.
- *Monterey-Salinas Transit*. The agency is in the planning phase of a future capital project that will reduce travel time on State Route 1. The respondent noted that most of the agency's state transit projects are still in process, which makes it difficult to report on outcomes.
- *San Diego Metropolitan Transit System*. Some projects, such as those funded by cap-and-trade programs, are expected to reduce GHG emissions by increasing transit ridership.
- *Torrance Transit System*. The agency's overall goal is to improve connectivity for public transportation services.

Related Resources

The resources below are organized in the following categories:

- Evaluation methods and tools.
- Greenhouse gas emissions.
- Land use.
- Ridership.
- Service quality.

Evaluation Methods and Tools

Research in Progress: Guidance for Calculating the Return on Investment in Transit State of Good Repair, TCRP Project E-12, start date: October 2016, expected completion date: April 2018.
Project description at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4118
From the project description: The objective of this research is to develop guidance for calculating a return on investment (ROI) for rehabilitating or replacing existing transit assets to help achieve state of good repair (SGR). This guidance should help transit agencies identify the full impacts of SGR investments versus other investment options. The guidance should be useful to transit agencies of different sizes and modes.

Evaluating Public Transit Benefits and Costs: Best Practices Guidebook, Todd Litman, Victoria Transport Policy Institute, July 2017.
http://www.vtpi.org/tranben.pdf
From the abstract: This guidebook describes how to create a comprehensive framework for evaluating the full impacts (benefits and costs) of a particular transit service or improvement. It identifies various categories of impacts and how to measure them. It discusses best practices for transit evaluation and identifies common errors that distort results. It discusses the travel impacts of various types of transit system changes and incentives. It describes ways to optimize transit benefits by increasing system efficiency, increasing ridership and creating more transit oriented land use patterns. It compares automobile and transit costs, and the advantages and disadvantages of bus and rail transit. It includes examples of transit evaluation, and provides extensive references. Many of the techniques in this guide can be used to evaluate other modes, such as ridesharing, cycling and walking.

"Assessment Methods from Around the World Potentially Useful for Public Transport Projects," Eric Bruun and Marianne Vanderschuren, *Journal of Public Transportation*, Vol. 20, No. 2, pages 103-130, 2017.
Citation at http://dx.doi.org/10.5038/2375-0901.20.2.6
From the abstract: This paper provides an overview of assessment methods used to evaluate public transport investments. Positive and negative aspects of various assessment tools are identified and discussed. Some developing world examples appear to be more elaborate and appropriate, than developed world examples, including examples from the United States (U.S.). Although the authors conclude that all methods/tools have challenges, they are of the opinion that a broad and inclusive assessment of public transport investment projects is a must and that the narrowly analyzed and ad-hoc investments witnessed around the world should be avoided.

TCRP Synthesis 128: Practices for Evaluating the Economic Impacts and Benefits of Transit, Glen Weisbrod, Naomi Stein, Chandler Duncan and Adam Blair, 2017.
Report available at http://www.trb.org/Main/Blurbs/175968.aspx
From the project description: TRB's Transit Cooperative Research Program (TCRP) Synthesis 128: Practices for Evaluating the Economic Impacts and Benefits of Transit provides state-of-the-practice information for transit agencies to help them in incorporating economic benefits and impacts into their decision-making processes, which may lead to more sustainable funding solutions for transit agencies. The report describes the methods used for assessing transit economic impacts and benefits, the types of effects that are covered by these methods, and the ways that agencies are using the information obtained for planning, prioritizing, funding and stakeholder support.

TCRP Report 176: Quantifying Transit's Impact on GHG Emissions and Energy Use—The Land Use Component, Frank Gallivan, Eliot Rose, Reid Ewing, Shima Hamidi and Thomas Brown, 2015.
Report available at http://www.trb.org/Publications/Blurbs/172110.aspx
From the foreword: This research project was undertaken to (1) identify, describe, and quantify the synergistic interaction between transit and land use and the effects on transportation-related GHG emissions and energy use and (2) develop a methodology to quantify the transportation-related GHG emissions and energy use related to land use changes that can be attributed to transit.

The final report is a concisely written document that

- Presents transit's impact on GHG emissions and energy use, including both the ridership effects and the land use effects;
- Introduces and provides a user's guide to the calculator tool;
- Identifies future research; and
- Includes two technical appendices pertaining to the use of statistical models in this research.

The calculator tool allows the user to estimate the land use benefits of the existing regional transit system, a regional transit plan, a new transit route or improved transit service along an existing corridor, a new transit station or stop, or improved transit service to an existing station or stop. All land use benefits are estimated in terms of reduction in vehicle miles traveled, gasoline consumption reduced, and GHG emissions saved. The calculator tool is posted on the *TCRP Report 176* summary web page of the TRB website and can be accessed at www.trb.org/main/blurbs/172110.aspx.

Assessing and Comparing Environmental Performance of Major Transit Investments, *TCRP Web-Only Document 55*, 2012.
Report available at http://www.trb.org/Main/Blurbs/167136.aspx
From the summary of research objectives and findings: Transit Cooperative Research Program (TCRP) Project H-41 addresses the need for new measures of the environmental benefits of transit investments. The objective of this research is to present, evaluate and demonstrate criteria, metrics and methods for assessing and comparing the environmental performance of major transit investments. The research was undertaken to offer decision makers optional criteria, metrics and methods for assessing transit projects with regard to environmental performance.

Greenhouse Gas Emissions

"Public Transit Investment and Sustainable Transportation: A Review of Studies of Transit's Impact on Traffic Congestion and Air Quality," Justin Beaudoin, Y. Hossein Farzin and C.-Y. Cynthia Lin Lawell, *Research in Transportation Economics*, Vol. 52, pages 15-22, October 2015.
Citation at http://dx.doi.org/10.1016/j.retrec.2015.10.004
From the abstract: In this paper we provide a framework for evaluating public transit investment, taking account of the effects of transit investment on traffic congestion and air quality. We discuss how to assess the sustainability of transit investment and the mechanisms through which public transit investment can affect equilibrium auto travel volumes and the associated congestion and air quality outcomes. Several related issues are addressed: the differences between short-run and long-run equilibria; the role of regional heterogeneity; regulatory and policy considerations; and the potential endogeneity of transit investment when conducting empirical analyses. … Reviewing the recent empirical literature, it appears that transit can both reduce congestion and improve air quality, but the magnitudes of these benefits are uncertain and may be specific to each location.

"Calculators to Estimate Greenhouse Gas Emissions from Public Transit Vehicles," Brent Weigel, Frank Southworth and Michael Meyer, *Transportation Research Record 2143,* pages 125-133*,* December 2010*.*
Citation at http://trrjournalonline.trb.org/doi/abs/10.3141/2143-16
From the abstract: This paper reviews calculation tools available for quantifying the greenhouse gas emissions associated with different types of public transit service and the tools' usefulness in helping a transit agency to reduce its carbon footprint through informed vehicle and fuel procurement decisions. Available calculators fall into two categories: (*a*) registry- and inventory-based calculators most suitable for standardized voluntary reporting, carbon trading, and regulatory compliance and (*b*) life-cycle analysis calculators that seek comprehensive coverage of all direct and indirect emissions. Despite significant progress in calculator development, no single calculator contains all information needed by transit agencies to develop a truly comprehensive, life cycle-based accounting of the emissions produced by vehicle fleet operations and for a wide range of vehicle and fuel technology options.

Land Use

Impacts of Bus Rapid Transit (BRT) on Surrounding Residential Property Values, Victoria A. Perk, Martin Catalá, Maximillian Mantius and Katrina Corcoran, National Institute for Transportation and Communities, July 2017.
http://ppms.trec.pdx.edu/media/project_files/NITC_894_Impacts_of_BRT_on_Surrounding_Residential_Property_Values.pdf
From the abstract: This research contributes to the relatively small body of literature on property value impacts of BRT in the U.S. by conducting a case study on Lane Transit District's EmX BRT service (Eugene, Oregon) using econometric modeling techniques to estimate changes in property values associated with the BRT. The analysis is based on hedonic price regression analysis, where sale prices are modeled using several property characteristics that contribute to the market or sale price. The findings of this research indicate that the EmX BRT system does positively impact surrounding single-family home sale prices.
….

These results provide further insight into how BRT services can enhance the livability and economic development in a community, and provide policymakers and the transit industry

throughout the U.S. with the best information possible to make informed transit investment decisions in their communities.

"Assessing the Impact of Proposed Transit Investments and Public Policy Choices on Land Use Patterns (A Simulation Approach with UrbanSim)," Chanyoung Lee and Zhenyu Wang, Florida Department of Transportation, October 2012.
http://www.fdot.gov/research/Completed_Proj/Summary_PTO/FDOT-BDK85-977-26-rpt.pdf
From the abstract: This study aims to develop an UrbanSim model to assess the changes that might result in a specific geographic area from a decision to construct a Bus Rapid Transit investment in Hillsborough County, Florida. UrbanSim has the potential to be a powerful tool in evaluating the benefits of transit investments because it works on a much smaller geographic scale than other alternative systems and can simulate location decisions made by individual business and families. Data on parcels, households, jobs, and land plans were collected for the base year (2010) from various data resources, such as the county appraiser, census database, InfoUSA, etc. The Tampa Bay Regional Planning Model (TBRPM) model was used to produce a traffic pattern forecast. The model was validated by comparing the simulation results to the projected demographic data in the Hillsborough County MPO 2035 Long Range Transportation Plan (LRTP). Four scenarios with different ridership levels were created of the proposed Bus Rapid Transit (BRT) investment using a short-term period (2010-2012) and a long-term period (2010-2020). The scenarios were compared to the ones without the proposed BRT route in the same years. This study found that the change in land use patterns is complex due to implementing the BRT service, either in a short-term (2010-2012) or a long-term period (2010-2020). The proposed BRT service has significant impacts on land use patterns in a long-term period (2010-2020).

Ridership

"Explaining Transit Ridership: What Has the Evidence Shown?," B.D. Taylor and C.N.Y. Fink, *The International Journal of Transportation Research*, Vol. 5, No. 1, pages 15-26, 2013. Citation at https://doi.org/10.1179/1942786712Z.0000000003
From the abstract: A host of factors no doubt influence transit ridership, including fares, routing, service frequency, stop/station accessibility, safety, private vehicle ownership levels, population density, land use, parking availability, and cost. But the relative importance of these factors and the ways they influence one another is less well understood. At the same time, the relationships between these factors and transit ridership are central to public policy debates about transportation system investments and the pricing and deployment of transit services. … [T]his paper reviews research on transit use, critiques the sometimes significant weaknesses in much of the previous work on this topic, draws conclusions from the more rigorous studies about which factors most influence transit use, and presents recommendations for future research.

TCRP Report 153: Guidelines for Providing Access to Public Transportation Stations, Kathryn Coffel, Jamie Parks, Conor Semler, Paul Ryus, David Sampson, Carol Kachadoorian, Herbert S. Levinson and Joseph L. Schofer, 2012.
http://www.reconnectingamerica.org/assets/Uploads/20120327tcrprpt153.pdf
From the foreword: TCRP Report 153: Guidelines for Providing Access to Public Transportation Stations provides a process and spreadsheet-based tool for effectively planning for access to high capacity transit stations, including commuter rail, heavy rail, light rail, bus rapid transit (BRT), and ferry. The report is accompanied by a CD that includes the station access planning spreadsheet tool that allows trade-off analyses among the various access modes (automobile, transit, bicycle, pedestrian, and transit-oriented development) for different station types. The potential effectiveness of transit-oriented development opportunities to increase transit ridership

is also assessed. This report and accompanying materials are intended to aid the many groups involved in planning, developing and improving access to high capacity transit stations, including public transportation and highway agencies, planners, developers, and affected citizens.

Service Quality

Research in Progress: The Relationship Between Transit Asset Condition and Service Quality, TCRP Project E-11, start date: November 2015, expected completion date: May 2017. (The web site notes that "[a]n interim report is expected in early 2017 that will be followed by an interim panel meeting.")
Project description at http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3745
From the project description: The body of asset management research and the Asset Management Guide (FTA Report 0027, October 2012) acknowledge that asset condition encompasses a broad spectrum of factors that include age, inspected asset condition and performance. The body of transit service quality research is documented in Transit Capacity and Quality of Service Manual (TCQSM, Edition 3, TCRP Report 165, 2014).

While many factors affect transit service quality (e.g., weather, environmental factors, service design, special events, congestion, asset condition, etc.), research is needed that focuses only on asset conditions as variables affecting transit service quality. More specifically, this research must consider what empirical data, assumptions and analyses are needed to estimate how asset conditions affect transit service quality.

Currently there is insufficient empirical evidence to support the quantitative relationships between asset condition and transit service quality. Clearly establishing the connection between asset condition and service quality will allow transit agencies and the public transportation industry, as a whole, to make better investment decisions.

Appendix A: Survey Results

The full text of each survey response is provided below. For reference, we have included an abbreviated version of each question before the response. The full question text appears on page 7 of this Preliminary Investigation. Responses have been edited for clarity.

Alameda-Contra Costa Transit District

Contact: Peter Brown, Capital Planning and Grants Manager, Finance Division, Alameda-Contra Costa Transit District, 510-891-7164, pbrown@actransit.org. (Note: The survey respondent completed only the first section of the survey.)

Determining Project-Level Funding and Impacts

1. **Software or tool:** Yes. PeopleSoft, Ellipse, Prophix.
2. **Methodology used to determine project-level impact:**

   Accessibility: Required by ADA [Americans with Disabilities Act].

   Costs: We try to minimize costs and track budget, scope and schedule for delivery.

   Greenhouse gas emissions: We track this for ZEB [zero-emission bus] and diesel fleets.

   Land use: We don't track land use since we do not have land use authority.

   Mobility: We don't track this aside from ridership.

   Safety: Detailed tracking and reporting.

   Service quality: Detailed tracking and reporting.

   Transit ridership: Detailed tracking and reporting.

   Travel time: Detailed tracking and reporting.

Fresno County Rural Transit Agency

Contact: Gilbert Garza, Senior Transit Planner, Fresno County Rural Transit Agency, 559-263-8019, ggarza@fresnocog.org.

Determining Project-Level Funding and Impacts

1. **Software or tool:** No.
2. **Methodology used to determine project-level impact:**

   Accessibility: Not applicable. Other than acquiring ADA-accessible vehicles (which is required by government mandate), FCRTA [Fresno County Rural Transit Agency] does not have any grant projects that address accessibility.

   Costs: Grant project costs are typically tracked through generally accepted accounting methods, and no other software or tools are used. Typically in a grant project, FCRTA is not asked to determine if a grant project is saving a certain amount of money or if the grant project is positively or negatively impacting the overall costs of the FCRTA transit operation. This would be very difficult for FCRTA to estimate in any case. Sometimes certain grant projects are presumed (by the funder and FCRTA) to have a positive

impact on transit operating costs simply by the nature of the grant project in question.

Greenhouse gas emissions: Typically, if a grant project involves emissions calculations or explicitly addressed GHG [greenhouse gas] emissions, the emissions benefit is determined by calculations made during the writing of the grant prior to funding, and little if any reporting is done after funding. An exception to this is the LCTOP [Low Carbon Transit Operations Program] grant program where FCRTA is required to enter data into an emission reduction "tool" in order to derive emissions reduced by the grant project.

Land use: Not applicable. FCRTA does not have any construction or infrastructure projects that would have any impact on land use in the FCRTA service area.

Mobility: Not applicable. Typically, all projects involving the expansion of the transit fleet are considered (by the funder and FCRTA) to be increasing mobility in the FCRTA service area and/or the local region.

Safety: Many FCRTA grant projects are undertaken with the specific aim of making specific investments to address certain aspects of safety for the FCRTA transit system. Specific issues or problems are identified by FCRTA staff with the remedy being the safety equipment or program specified in the grant project. An example would be unsafe bus storage areas made safer by the installation of security gates and security cameras acquired through a grant project.

Service quality: An analysis of FCRTA transit statistics usually determines if a grant project is resulting in FCRTA being more efficient (on time) or being able to offer more service. Also, rider surveys and complaint statistics help FCRTA determine how satisfied its riders are with service quality.

Transit ridership: An analysis of FCRTA transit statistics determines the effect that a grant project is having on ridership either systemwide or specific to the grant project.

Travel time: An analysis of FCRTA transit statistics determines the effect of a relevant grant project on travel time either systemwide or specific to the grant project.

2A. **Other factors and methodology used:** Societal factors. In recent years many grant funders have identified disadvantaged communities and/or environmental justice as considerations or conditions to address in a grant project. This has typically applied to FCRTA in determining where a grant project will take place or [in] which service area a grant project activity will take place.

Gathering Data and Tracking Outcomes

3. **Project-related data used to assess impact of project investment:** FCRTA is typically required to make reports on either an annual or semiannual basis, which include project narratives and/or data which are entered into either Word or Excel files or into web sites. Typical information provided are updates on project tasks, accomplishments, and transit operational data such as ridership or a listing of transit equipment or vehicles acquired.

4. **How data is gathered:** Grant project data comes from a variety of sources: databases or spreadsheets created by FCRTA staff, interest and expense data from FCRTA accounting department, transit statistics provided by FCRTA transit operations contractor.

5. **When data is gathered:**
    - Monthly.
    - Quarterly.

- Twice a year.
- Annually.
- Every two years.
- Every three years.
- All of the above either have applied in past projects or do apply currently, depending upon the reporting requirements of each grant project, grant funder or other applicable requirements.

6. **Quantified project-level investments?** No.
7. **Seeking to link a transit investment to an outcome?** Yes. Because most grant funders create specific grant programs for specific outcomes and FCRTA is promising through its grant application that it will carry out a grant project, if funded, to accomplish the specified outcomes of the grant program.
8. **Reporting to track project investments:** See answer to question #3.
9. **Documents:** Not applicable.

Comments or additional information: [No response.]

Glenn County

Contact: Mardy Thomas, Principal Planner, Glenn County Transportation Commission/Glenn County, 530-934-6530, mthomas@countyofglenn.net.

Determining Project-Level Funding and Impacts

1. **Software or tool:** No.
2. **Methodology used to determine project-level impact:**

   Accessibility: We require all vehicle purchases to be compliant with the ADA.

   Costs: We consider quality of the purchase and the estimated life of the asset.

   Greenhouse gas emissions: Rely on CARB [California Air Resources Board] and local air district guidance.

   Land use: Projects should be compatible with areas in which they are placed. Geographical dispersion is also considered.

   Mobility: Projects are placed where existing pedestrian facilities exist, if possible.

   Safety: Projects must be placed to allow safe entry and departure of vehicles and passengers.

   Service quality: Consider current passenger interactions with facilities and vehicles, driver observations and ridership metrics.

   Transit ridership: Consideration is given to past efforts and requests during the unmet needs process.

   Travel time: Placement of facilities/amenities is done to maximize efficiencies due to headway times. [Federal Transit Administration defines headway as “the time interval between vehicles moving in the same direction on a particular route”; see https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary.]

2A. **Other factors and methodology used:** Effect on existing fleet; reduction in maintenance costs.

Gathering Data and Tracking Outcomes

3. **Project-related data used to assess impact of project investment:** Generally, ridership metrics. Maintenance expenditures/downtime.
4. **How data is gathered:** Regular operation and periodic budget review.
5. **When data is gathered:**
   - Monthly.
   - Quarterly.
   - Annually.
6. **Quantified project-level investments?** Yes. With purchase of newer, heavier duty vehicles, an evaluation was made of maintenance costs between previous vehicles and new vehicles. Subject data on passenger satisfaction was also collected.
7. **Seeking to link a transit investment to an outcome?** Yes. Generally, lower maintenance and greater longevity in vehicles. Higher ridership.
8. **Reporting to track project investments:** The reporting does not directly address the project but the transit operation collects program indicators on costs and ridership performance relative to the investment.
9. **Documents:** [No response.]

Comments or additional information: Overall, we do not formally evaluate projects. However, the performance metrics are closely watched and it is generally evident that there is impact of investment on the service.

Livermore Amador Valley Transit Authority

Contact: Jennifer Yeamans, Senior Grants, Project Management and Contract Specialist, Livermore Amador Valley Transit Authority, 925-455-7561, jyeamans@lavta.org.

Determining Project-Level Funding and Impacts

1. **Software or tool:** No.
2. **Methodology used to determine project-level impact:**

   Accessibility: Change in riders served.

   Costs: [No response.]

   Greenhouse gas emissions: Use CARB's online tool as appropriate.

   Land use: Not applicable.

   Mobility: Change in ridership/boardings.

   Safety: New safety/security measures implemented.

   Service quality: Standard service quality metrics provided for in agency O&M [operations and maintenance] contract.

   Transit ridership: Boardings.

Travel time: May be corridor-specific, as needed.

2A. **Other factors and methodology used:** [No response.]

Gathering Data and Tracking Outcomes

3. **Project-related data used to assess impact of project investment:** Not applicable.
4. **How data is gathered:** We rely on existing data sources that we already collect such as automatic passenger counts, NTD [National Transit Database] data and passenger survey data.
5. **When data is gathered:** We don't do project-related data gathering.
6. **Quantified project-level investments?** No.
7. **Seeking to link a transit investment to an outcome?** Yes. Most of our investments aim to increase ridership and improve the customer experience.
8. **Reporting to track project investments:** [No response.]
9. **Documents:** [No response.]

Comments or additional information: [No response.]

Marin Transit

Contact: Lauren Gradia, Director of Finance and Capital Programs, Marin Transit, 415-226-0861, lgradia@marintransit.org.

Determining Project-Level Funding and Impacts

1. **Software or tool:** No.
2. **Methodology used to determine project-level impact:**

Accessibility: Marin Transit monitors the impacts of service accessibility through our Short Range Transit Plan [see **Documents** below]. This document is updated every two years. Goal C is "provides accessible transit services within Marin County." The District tracks the percentage of how many residents, major employers and schools are within 1/4 mile of a transit stop. We also look at stop level accessibility by maintaining a bus stop inventory. Capital projects to improve bus stops make a small impact systemwide but only by addressing each individual stop do we improve the system.

Costs: Marin Transit's Goal G is "meet cost efficiency standards based on cost per revenue hour." This is tracked through our Short Range Transit Plan. This question is confusing.

Greenhouse gas emissions: We used the Caltrans tool for this for the LCTOP program.

Land use: Not applicable.

Mobility: Marin Transit monitors mobility by tracking total ridership monthly, quarterly, annual[ly], and in the Short Range Transit Plan. If warranted, Marin Transit also tracks passenger trips for a project (route, service, etc.).

Safety: We track accidents and road calls.

Service quality: Marin Transit completes period[ic] passenger surveys. Marin Transit

has a goal of “ensuring high levels of customer satisfaction with services.” We track our performance in our Short Range Transit Plan.

Transit ridership: We track ridership by route, program and system. We report these to the board monthly. We also monitor stop level ridership using a 100 percent ridecheck and automatic passenger counters. [Ridecheck is “a comprehensive survey of all local bus routes, trips and stops” that “provides the agency with a detailed picture of local transit ridership.”]

Travel time: Goal E in our Short Range Transit Plan is “provides competitive travel times to promote transit usage.” Marin Transit monitors at scheduled times versus equivalent auto travel times.

2A. **Other factors and methodology used:** This survey is difficult to complete because projects range from service operation to bus stop improvements. In general, we pick projects that meet our system objectives and then we monitor and track our performance on a system level through our Short Range Transit Plan. Detailing project-level impacts can be difficult and is not always warranted, logical or possible.

Gathering Data and Tracking Outcomes

3. **Project-related data used to assess impact of project investment:** This is highly dependent on the project type. Again, monitoring on a systemwide basis tends to be more relevant and then documenting what projects help create the systemwide improvements. Too much focus on result from small project grants may not be productive.

4. **How data is gathered:** Passenger surveys, fareboxes, automatic passenger counters, ridechecks, inventories and contractor reports.

5. **When data is gathered:**
   - Monthly.
   - Quarterly.
   - Annually.
   - Every two years.

6. **Quantified project-level investments?** Yes. What does this even mean? Yes, we know how much we spend on individual projects. We know how much state and federal funding we receive and we know exactly where it goes. We track everything through the accounting software by projects.

7. **Seeking to link a transit investment to an outcome?** Yes. We strive to link providing transit to the mobility and congestion relief it provides. This helps the communities see the value in funding transit through their tax dollars.

8. **Reporting to track project investments:** Annual budget, quarterly financial reports, annual CAFR [Comprehensive Annual Financial Report] and Short Range Transit Plan.

9. **Documents:**

   2018-2027 Short Range Transit Plan, Draft, Marin Transit, November 2017.
   http://www.marintransit.org/pdf/SRTP/2018-2027/2018-2027SRTP_DRAFT.pdf
   From the draft plan: An up-to-date Short Range Transit Plan (SRTP) guides Marin Transit’s investments in the future. It is a living document that uses current information, financial resources, and performance targets to plan for local public transit services. The SRTP balances Marin Transit’s projected costs and revenues over a five-year timeframe, and is designed to provide a ten-year vision of the future.

Comprehensive Annual Financial Report: For the Years Ended June 30, 2017 and 2016, Marin County Transit District, November 2017.
http://www.marintransit.org/pdf/finance/FY2017_MCTD_CAFR.pdf
This is the agency's most recent annual financial report.

Comments or additional information: It was difficult to understand what you wanted in this survey.

Monterey-Salinas Transit

Contact: Michelle Overmeyer, Accounting/Grants Analyst, Monterey-Salinas Transit, 831-264-5877, movermeyer@mst.org.

Determining Project-Level Funding and Impacts

1. **Software or tool:** No.
2. **Methodology used to determine project-level impact:**

   Accessibility: Feedback from MST's [Monterey-Salinas Transit] Mobility Access Committee.

   Costs: Expenses are reviewed monthly or quarterly.

   Greenhouse gas emissions: Emissions are evaluated using Caltrans and/or [C]ARB tools required for semiannual reporting.

   Land use: Communication with local municipalities.

   Mobility: Feedback from MST's Mobility Access Committee.

   Safety: Review from MST's risk and security manager.

   Service quality: Customer feedback.

   Transit ridership: Monthly tracking.

   Travel time: Monthly on-time performance.

2A. **Other factors and methodology used:** [No response.]

Gathering Data and Tracking Outcomes

3. **Project-related data used to assess impact of project investment:** Ridership, passenger miles travelled, vehicle revenue hours and vehicle revenue miles.
4. **How data is gathered:** Farebox data collection system, field observations and scheduling software.
5. **When data is gathered:**
   - Monthly.
   - Quarterly.
   - Twice a year.
   - Annually.
   - Every three years.
6. **Quantified project-level investments?** No.

7. **Seeking to link a transit investment to an outcome?** Yes, MST is in the planning phase of a future capital project that will reduce travel time on S[tate] R[oute] 1.
8. **Reporting to track project investments:** Accounting software, reporting formats required by Caltrans.
9. **Documents:** You can reach out to PTMISEA [Public Transportation Modernization, Improvement, and Service Enhancement Account Program; see http://www.dot.ca.gov/drmt/spptmisea.html] for final closeout reports.]

Comments or additional information: Most of our projects under state transit programs are still in process, so it is difficult to report on outcomes.

San Diego Metropolitan Transit System

Contact: Gordon Meyer, Finance/Capital Grants Analyst, San Diego Metropolitan Transit System, 619-595-1014, gordon.meyer@sdmts.com.

Determining Project-Level Funding and Impacts

1. **Software or tool:** Yes. MTS [Metropolitan Transit System] recently implemented SAP Budget and Planning (SBP) module for managing the annual capital improvement program process. Projects are prioritized and ranked based [on] established criteria regarding project benefits.
2. **Methodology used to determine project-level impact:**

   Accessibility: MTS does not typically monitor project impacts on accessibility except when required by specific funding agreements. For example, Low Carbon Transit Operations Program (LCTOP) funding requires reporting on ridership impacts and subsequent GHG reductions. In this case, MTS tracks and reports impacts on ridership at specific locations affected by the project.

   Costs: MTS uses SAP ERP [Enterprise Resource Planning] software for all accounting functions. Capital budget and expenditures are tracked within SAP as well as operating budgets and costs. The finance department tracks changes in operating costs but does not typically track changes that are directly attributed to capital investments.

   Greenhouse gas emissions: MTS does not monitor greenhouse gas emissions unless required by specific grant programs. For instance, LCTOP requires analysis and reporting of GHG reduction at the project level.

   Land use: Not applicable.

   Mobility: MTS does not typically monitor project impacts on accessibility except when required by specific funding agreements. For example, LCTOP funding requires reporting on ridership impacts and subsequent GHG reductions. In this case, MTS tracks and reports impacts on ridership at specific locations affected by the project.

   Safety: MTS measures and reports key performance indicators [KPIs] related to safety such as preventable accidents. These KPIs are measured at the organizational level rather than project level.

   Service quality: MTS measures and reports key performance indicators related to service quality such as mean distance between failures, on-time performance, number of complaints, etc. These KPIs are measured at the organizational level rather than project level.

Transit ridership: MTS does not typically monitor project impacts on accessibility except when required by specific funding agreements. For example, LCTOP funding requires reporting on ridership impacts and subsequent GHG reductions. In this case, MTS tracks and reports impacts on ridership at specific locations affected by the project.

Travel time: MTS measures on-time performance for different service types but not at the project level.

2A. **Other factors and methodology used:** Not applicable.

Gathering Data and Tracking Outcomes

3. **Project-related data used to assess impact of project investment:** When required, MTS uses data from SAP ERP software, ridership tracking software, etc.
4. **How data is gathered:** The data is usually tracked electronically automatically or inputted manually into a database for reporting purposes.
5. **When data is gathered:** As needed.
6. **Quantified project-level investments?** Question [is] not clear. MTS tracks impact when required.
7. **Seeking to link a transit investment to an outcome?** Yes. Some projects such as those funded by cap-and-trade programs are expected to reduce greenhouse gases by increasing transit ridership.
8. **Reporting to track project investments:** MTS tracks all capital expenditures and reports on benefits as required by each program.
9. **Documents:** Not applicable.

Comments or additional information: Not applicable.

Torrance Transit System

Contact: James Lee, Transit Administration Manager, Torrance Transit System, 310-781-6924, jameslee@torranceca.gov.

Determining Project-Level Funding and Impacts

1. **Software or tool:** Torrance Transit utilizes a software call Remix to estimate the cost of launching a new service/route, or the modification of existing service.
2. **Methodology used to determine project-level impact:**

Accessibility: Bus stop locations are surveyed beforehand to determine ADA accessibility, as well as the installation of amenities.

Costs: Average cost of stop maintenance and upkeep is factored into the project.

Greenhouse gas emissions: Torrance Transit is a 100 percent alternative-fuel bus fleet. Annual reductions in greenhouse gas emissions are tracked and reported.

Land use: Prior to the launch of project, land use is [assessed] to determine best use of service and capital.

Mobility: Bus service is surveyed and analyzed to determine the effectiveness of mobility and service connections.

Safety: All locations are surveyed for patron and operator safety in terms of traffic level, lighting, etc.

Service quality: Passenger surveys are regularly conducted to determine service quality. Data from our automatic vehicle locator (AVL) system is also analyzed to determine service quality and efficiency.

Transit ridership: Through the use of our AVL system and automatic passenger counters, we can assess the number of boardings and alightings at all locations.

Travel time: Same as above. Analyzing data gathered from our AVL system allows us to study travel time and patterns.

2A. **Other factors and methodology used:** Not applicable.

Gathering Data and Tracking Outcomes

3. **Project-related data used to assess impact of project investment:** AVL system data, comprehensive operational analysis, public meetings/hearings, passenger mile studies and line-by-line analysis.

4. **How data is gathered:** Through technology, in-person surveys and public meetings.

5. **When data is gathered:**
   - Quarterly.
   - Annually.
   - Every three years.
   - Varies based upon type of report or information being gathered.

6. **Quantified project-level investments?** Yes. Project-level investments are reviewed to determine their effectiveness and efficiency.

7. **Seeking to link a transit investment to an outcome?** Yes. The overall goal is to improve regional connectivity for public transportation services.

8. **Reporting to track project investments:** AVL system-based data (automatic passenger counter system is certified) and National Transit Data[base] (NTD) data.

9. **Documents:**

   "Public Transit GM Q&A: What Has Been the Impact of New Technology?," *Metro Magazine*, May 2017.
   http://www.metro-magazine.com/management-operations/news/722323/apta-question-of-the-day-the-impact-of-new-tech
   This online magazine article includes the following from Torrance Transit System's transit director:

   > In April of this year, we implemented our Automatic Vehicle Locator system that provides real-time bus arrival information on mobile devices via mobile applications and text messaging. The technology improves the customer experience by providing ADA-compliant displays and announcements. The system also aids us with data collection for scheduling/service planning, increases passenger-operator safety, promotes efficiency and decreases operational costs.

   The National Transit Database, Federal Transit Administration, 2017.
   https://www.transit.dot.gov/ntd
   This web site provides a link to the National Transit Database and related resources.

From the web site:

> The NTD is designed to support local, state and regional planning efforts and help governments and other decision-makers make multi-year comparisons and perform trend analyses. It contains a wealth of information such as agency funding sources, inventories of vehicles and maintenance facilities, safety event reports, measures of transit service provided and consumed, and data on transit employees.

Comments or additional information: Thank you!

Yolo County Transportation District

Contact: Michael Luken, Deputy Director, Yolo County Transportation District, 530-402-2830, mluken@yctd.org.

Determining Project-Level Funding and Impacts

1. **Software or tool:** No.
2. **Methodology used to determine project-level impact:**

   Accessibility: Case-by-case internal agency analysis.

   Costs: Case-by-case internal agency analysis.

   Greenhouse gas emissions: Cal EPA [Environmental Protection Agency] software tool.

   Land use: Case-by-case internal agency analysis.

   Mobility: Case-by-case internal agency analysis.

   Safety: Case-by-case internal agency analysis.

   Service quality: Case-by-case internal agency analysis.

   Transit ridership: Case-by-case internal agency analysis on ridership. On-off direct survey or video survey with on-board camera systems.

   Travel time: Case-by-case internal agency analysis.

2A. **Other factors and methodology used:** [No response.]

Gathering Data and Tracking Outcomes

3. **Project-related data used to assess impact of project investment:** Ridership, rides per hour.
4. **How data is gathered:** On-board, in-person on-off survey and video survey.
5. **When data is gathered:**
   - Every three years.
   - Project-level analysis.
6. **Quantified project-level investments?** Yes. On-board, in-person on-off survey and video survey.
7. **Seeking to link a transit investment to an outcome?** No.
8. **Reporting to track project investments:** National Transit Database monthly and annual

reports.

9. **Documents:** [No response.]

Comments or additional information: [No response.]