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East County Integrated Transit Study

Final Report

February 2022

Prepared by:



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Abbreviations

ABAG	Association of Bay Area Governments	MPH	Miles Per Hour
BART	Bay Area Rapid Transit	MSF	Maintenance and Storage Facility
BRT	Bus Rapid Transit	MTC	Metropolitan Transportation Commission
CARB	California Air Resources Board	O&M	Operations and maintenance
CBPP	Countywide Bicycle and Pedestrian Plan	OCS	Overhead Catenary System
CCC	Contra Costa County	OD	Origin-Destination
CCTA	Contra Costa Transportation Authority	PDA	Priority Development Areas
CIG	Capital Investment Grants	ROM	Rough Order of Magnitude
COC	Communities of Concern	ROW	Right-of-way
CPUC	California Public Utilities Commission	RTP	Regional Transportation Plan
CRT	Commuter Rail Transit	SCC	Standard Cost Category
DMU	Diesel Multiple Unit	SCS	Sustainable Communities Strategy
eBART	East Contra Costa County BART	SJJPA	San Joaquin Joint Powers Authority
EMU	Electric Mechanical Unit	SRTP	Short-Range Transit Plan
FCMU	Fuel Cell Multiple Unit	TAZ	Traffic Analysis Zone
GP	General Purpose	TEP	Transportation Expenditure Plan
HCT	High-Capacity Transit	TOD	Transit Oriented Development
HOV	High Occupancy Vehicle	TSP	Transit Signal Priority
ICT	Innovative Clean Transit	VMT	Vehicle Miles Travelled
IRS	Internal Revenue Service	ZE	Zero-Emission
IT	Information Technology	ZEV	Zero-Emission Vehicle
ITS	Intelligent Transportation Systems	SR-4	State Route 4
LPA	Locally Preferred Alternative	SR-160	State Route 160

1 EXECUTIVE SUMMARY

Project Background

The purpose of the East County Integrated Transit Study (ECITS), funded by a Caltrans grant, is to identify solutions for improving transit services between Brentwood and Antioch in East County. The Project team started by identifying core goals that are in alignment with all related projects and initiatives in the area and made sure each goal was centered around providing seamless travel options that are **sustainable, smart, user-friendly, and efficient**.

In addition to defining our study purpose and goals, key considerations were isolated based on the needs and wants of East County residents. Through this process the team learned that residents would be best served if the transit solution-

- Provides fast, frequent, cost-effective connection from Antioch BART to Innovation Center @ Brentwood
- Attracts high quality jobs and supports economic development
- Operates using clean fuels, not gas
- Optimizes accessibility and is easy to use
- Improves travel times and is reliable
- Considers the needs of transit agencies involved in the solution
- Addresses needs and barriers of all who may use the system

Existing Conditions

Many East County residents are bedroom commuters and super commuters, which is increasing the congestion and travel delays along State Route 4, and overall, impacts the quality of life for residents, employees, and visitors.

The population of **East County grew nearly 50% from 2000 to 2020** and is estimated to continue that trend in the coming decades. This rapid growth coupled with several transportation upgrades in the area like the eBART extension, updates to the Oakley Park and Ride lot, restructuring of Tri Delta bus service, and the planned Innovation Center @ Brentwood, set the stage for CCTA to take a closer look at transit in East County.

Alternatives Considered

There is a lot to consider in developing a study like this! The ECITS team carefully considered the benefits and impacts of many high volume, zero emission (ZE) transit options. Using the project goals and key considerations as a guide, the Project team assembled a set of six (6) alternatives for review- one rail option between Brentwood and Antioch, and five bus options with varying end points. The bus options would operate in either dedicated or transit-only spaces along SR-4 (like those for rail or Freeway Bus Rapid Transit – Freeway BRT), existing SR-4 travel lanes, or existing lanes along arterial roads.

1. eBART rail extension between Brentwood and Antioch
2. Freeway BRT in median from Brentwood to Antioch
3. Freeway BRT from Brentwood to Pittsburg/Bay Point
4. Express Bus from Brentwood to Antioch
5. Express Bus from Brentwood to Pittsburg/Bay Point
6. Rapid Bus on arterials from Brentwood to Antioch

Evaluation Results

During detailed evaluation, each alternative was scored on a scale of 1 to 5 (5 being the highest) based on comparative performance within a variety of criteria like travel time savings, vehicle miles traveled (VMT) reduction potential, carrying capacity, service flexibility, and cost effectiveness just to name a few. Each criterion was also assigned a weighted value, based on community and stakeholder feedback received related to the level of importance they felt toward each criteria category.

More than 50% of survey respondents supported all of the alternatives at least somewhat, but the rail alternative (#1) and the express bus alternatives (#4) ranked highest. Both of these alternatives will be studied further.

HIGHEST PERFORMING ALTERNATIVES

#1 eBART rail extension between Brentwood and Antioch

#4 Express Bus from Brentwood to Antioch

Community & Stakeholder Engagement

The Project team used a series of online open houses to engage with the public during this study. Through these events, survey feedback was gathered from 325 participants about a variety of topics including- mobility needs, the framework of the study, and community preferences on the six proposed alternatives. Online open house materials were available in over 108 languages and in print or other formats upon request.

Regular meetings with a Steering Committee and a Technical Advisory Committee were also a critical part of the study process. The Steering Committee brought the community's perspective to the study team and the Technical Advisory Committee provided input on the underlying assumptions and analyses used to evaluate alternatives. These committees were made up of representatives from the following key transit organizations and municipalities-

- Bay Area Rapid Transit (BART)
- Caltrans, District 4
- City of Antioch
- City of Brentwood
- City of Oakley
- Contra Costa County
- Office of Supervisor Diane Burgis
- TRANSPLAN
- Tri Delta Transit

LPA ADOPTION

The Project team took recommendations through an official approval process that involves acceptance by TRANSPLAN, BART, Tri Delta Transit, and the CCTA in November and December 2021.

During the CCTA Board Meeting on December 15th, the CCTA Board approved the motion to approve the recommendation of the Locally Preferred Alternative “for Alternative 4 Express Bus to Antioch as recommended in the study and move it to cost refinement and conceptual design, and advancing certain design elements of the higher cost Alternative 1 Bay Area Rapid Transit Rail Extension”

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CONCEPTUAL DESIGN and FINAL REPORT

The two highest ranked alternatives- extending Bart from Antioch to Brentwood (Alternative #1) and Express Bus from Brentwood to Antioch (Alternative #4)- were taken through a conceptual design process to identify infrastructure needs, construction costs, and operation details. The team also refined potential design treatments to support the highest ranked alternatives right-sized operating assumptions to incorporate the latest vehicle capacity and potential passenger demand information available. Updates to the preliminary capital and O&M cost estimates were made to inform possible funding sources.

NEXT STEPS

ECITS team developed a set of near- and long-term transit supportive policy considerations and strategic recommendations for regional transit providers and stakeholders to pursue in tangent with HCT project development.

2 PROJECT BACKGROUND

INTRODUCTION

East County is ethnically diverse and may become more diverse in the future as the area grows in population. Most of the study area is comprised of 50% or more people of color. The number of people living in East County has grown nearly 50% from 2000 to 2020 and is estimated to continue that trend in the coming decades. Over the last decade, Antioch, Brentwood, and Oakley grew by more than 100,000 people, accounting for more than 1/3 of Contra Costa County's total population growth.

Through the East County Integrated Transit Study (ECITS), the Contra Costa Transportation Authority (CCTA) studied different ways to improve transit service between Antioch and Brentwood. This is part of a continued effort to connect the eastern part of Contra Costa County to the rest of the county and the Bay Area. The ECITS provides the planning context and conceptual plan for delivering a fast, frequent, high-capacity, zero-emission (ZE) electric transit connection between Antioch and Brentwood in East Contra Costa County (East County). The ECITS is the next phase in the development and implementation of high-capacity transit (HCT) in East County. The previous phase, led by Bay Area Rapid Transit (BART), approved the eBART Next Segment Study in 2014. The eBART Next Segment study established the need for future extension of the BART Yellow Line along the State Route 4 (SR-4) corridor and evaluated potential station locations.

The ECITS developed a conceptual plan for delivering a fast, frequent, high-capacity and ZE transit connection along the SR-4 corridor between the Antioch BART station and the future Innovation Center @ Brentwood. The planned Innovation Center @ Brentwood is not currently served by fixed route transit service, nor is the SR-4 corridor segment directly represented by any existing transit service.

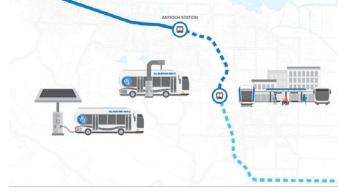
The ECITS developed an actionable set of near-term and long-term recommendations to implement HCT that extends from Antioch Station farther into East County. Recommendations considered the near-term need for a competitive transit alternative to driving to increase corridor peak capacity and access to regional job centers. A locally preferred alternative (LPA) was identified such that HCT service within the SR-4 corridor may grow and evolve with additional, long-term investments to support local employment growth and mobility improvements.

PROJECT GOALS AND OBJECTIVES

The ECITS, funded by a Caltrans grant, aims to identify solutions for improving transit services between Brentwood and Antioch. With the success of the recent eBART extension to Antioch, updates to the Oakley Park and Ride lot, a restructuring of Tri Delta bus services and the anticipation of the Innovation Center @ Brentwood, it was the right time for CCTA to take a closer look at transit in East County.

The ECITS developed six key Goals (Figure 1) through the assessment of existing conditions and transportation needs within the SR-4 Corridor and refined with input from regional stakeholders and members of the community. The project team also structured the core goals for this study to be in alignment with all related projects and initiatives in the area and each goal is centered around providing seamless travel options that are sustainable, smart, user-friendly, and efficient. Project goals provided the guiding framework for development potential transit alternatives, as well as the metrics and measures used to evaluate their potential benefits and/or impacts in the selection of an LPA.

Figure 1 | ECITS Project Goals

		
Improve Transit User Experience	Respond to Equitable Access Needs	Improve Air Quality
		
Support Economic Development	Allow for Flexible Expansion	Communicate Benefits of Transit

Refer to the Existing Conditions Report, October 2020, for further description of project Goals, Objectives, as well was potential constraints and opportunities

Needs & Purpose

Goal & Objectives

Identification & Initial Screening

Alternative Refinement & Evaluation

Preferred Alternative Selection

3 EXISTING CONDITIONS

The existing conditions memo details the existing corridor, demographics, transit and traffic conditions, and past studies related to the study area.

CORRIDOR OVERVIEW

The geographic limits of the study corridor for the ECITS include the SR-4 bypass from Antioch Station, near Hillcrest Avenue, to the future Innovation Center @ Brentwood, between Lone Tree Way and Sand Creek Road. There are limited alternatives to the SR-4 corridor. Past studies have ruled out the Mococo rail line, and of the arterial streets, only Deer Valley Road/Hillcrest Avenue has a parallel route to SR-4. The existing and planned land-use along Deer Valley/Hillcrest, as well as the comparatively slow travel times with that of SR-4 alignment, do not support potential HCT service. Many travelers continue to use the old SR-4 alignment, now called Main Street in Oakley and Brentwood Boulevard in Brentwood, however, it does not support the long-term fixed guideway HCT vision of a future BART extension and does not connect to the planned Innovation Center @ Brentwood.

The nine county Bay Area region designated planning areas for future growth within existing communities as Priority Development Areas (PDAs). Most new housing and jobs will be built within PDAs by 2050. The regional long-range plan, Plan Bay Area, aligned transportation and other investments with development in PDAs. PDAs have existing transit service, with minimum service frequency requirements, and have been near established job centers, retail districts, and/or other services. Plan Bay Area was developed by the Metropolitan Transportation Commission (MTC); however, local governments create land-use plans and policies for their PDAs.

Demographics

East County has grown substantially (nearly 50%) from 2000 to 2020 and has been estimated to continue that trend in the coming decades. This growth has spurred many suburban and rural areas to become more racially and economically diverse, especially as people search for more affordable housing in exchange for a longer commute. However, residential growth has not been matched by job growth, resulting in future residents travelling regionally, primarily westward, to access jobs in employment centers. Additionally, parts of northeastern Antioch and northwestern Oakley have been identified as communities of concern with significant concentrations of minority and low-income households. With SR-4 and BART as the primary transportation connections to East County, expansion of high-capacity transit will improve regional access to East County residents and support future economic development.

REVIEW OF PAST STUDIES AND FINDINGS

Local plans identify an expansion of high-capacity transit beyond the Antioch station as a key investment priority. Transportation Plans and General Plans developed for East County contrast the existing car-oriented landscape with an aspiration to increase transit, walking, and riding bicycles as everyday forms of transportation. There are regional multi-use trails from which to expand, particularly the Mokelumne Trail connection between Antioch and the planned Innovation Center @ Brentwood PDA. Expanding transit is also a priority for Tri Delta Transit, whose ongoing Short-Range Transit Plan (SRTP) update and Network Evaluation & Redesign study will identify transit network improvements to better serve East County. Economic development and high-paying local jobs are a priority of every General Plan in East County. Creating an appealing location to locate a business by providing a frequent and accessible transit connection is key element of the Innovation Center @ Brentwood Specific Plan.

EXISTING ROADWAY CONDITIONS

SR-4 is the primary regional transportation corridor for East County. Within the extents of the study area, the lane configurations vary between 2 and 4 general purpose (GP) lanes in each direction with high occupancy vehicle (HOV) lanes between Baily Road and Hillcrest Ave. The existing right-of-way (ROW) within the median SR-4 between Brentwood and Antioch Station has been preserved in support of future potential HCT options.

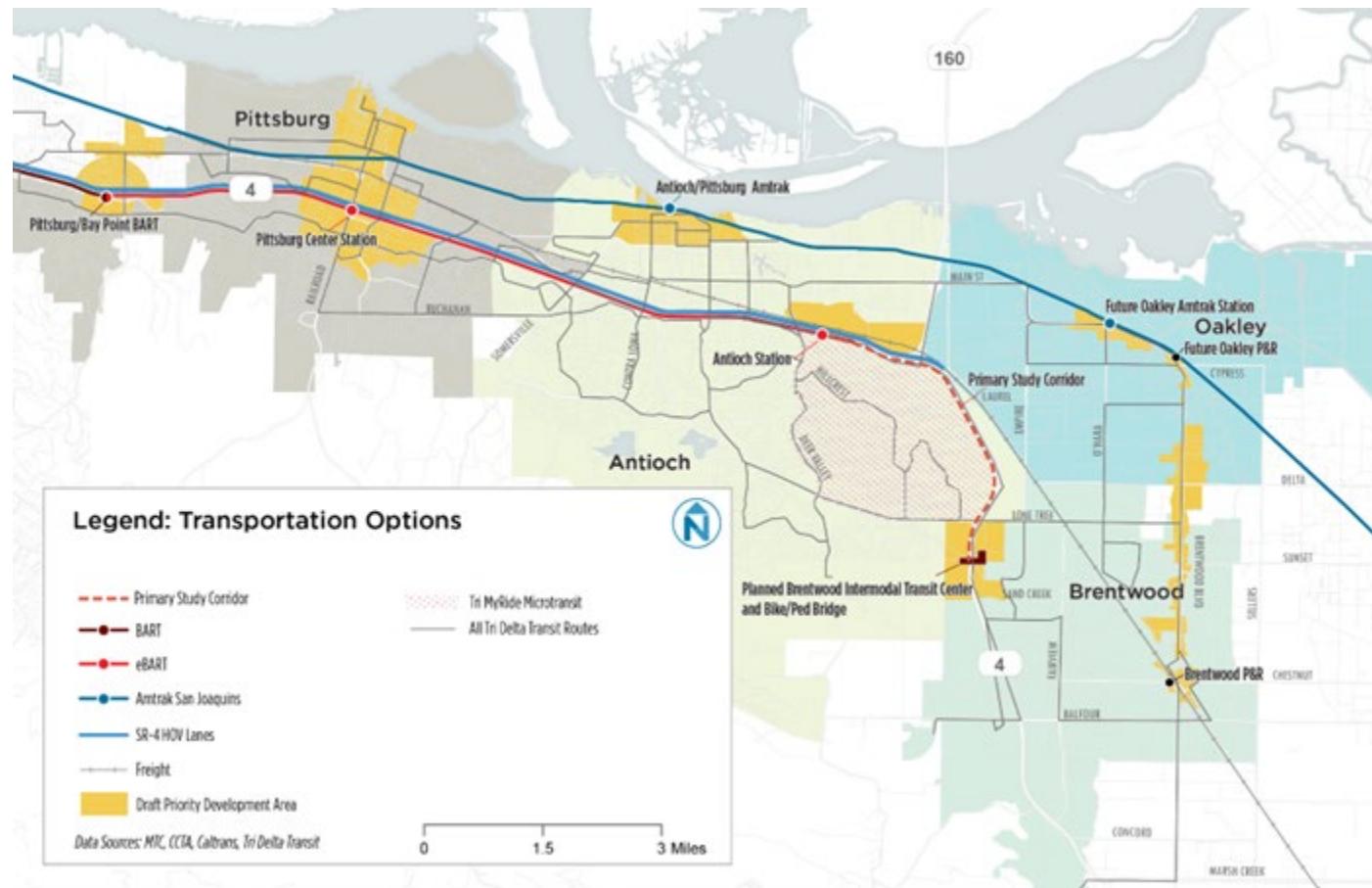
The most recent SR-4 improvement project was a new interchange at SR-4 and Balfour Road that opened in 2018. The roadway improvement elements of future (planned) projects would expand SR-4 from four to eight lanes between Loveridge Road in Pittsburg to just west of SR-160 in Antioch and from two to four lanes from Lone Tree Way to Balfour Road in Brentwood. The expansion includes HOV lanes with the potential to convert to express lanes in the future. Existing right-of-way within the SR-4 median has been preserved from Antioch Station to Brentwood, in support of future potential high-capacity transit extensions.

Weekday travel in East County is defined by travel in the morning west to regional job centers in Central Contra Costa County, Oakland, San Francisco, and Silicon Valley and travel east in the evening. Long-distance commuters from the Central Valley use SR-4 as one of the primary routes to reach Bay Area job centers and to reach BART. The SR-4 corridor and other connecting highways experience significant congestion during the peak commute hours.

As the population of East County continues to grow, the peak travel, the peak period drive times along SR-4 will continue to worsen. From Antioch Station, BART provides significant commuter travel time savings for jobs located near a BART station.

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Figure 2 | ECITS Study Area



EXISTING TRANSIT CONDITIONS

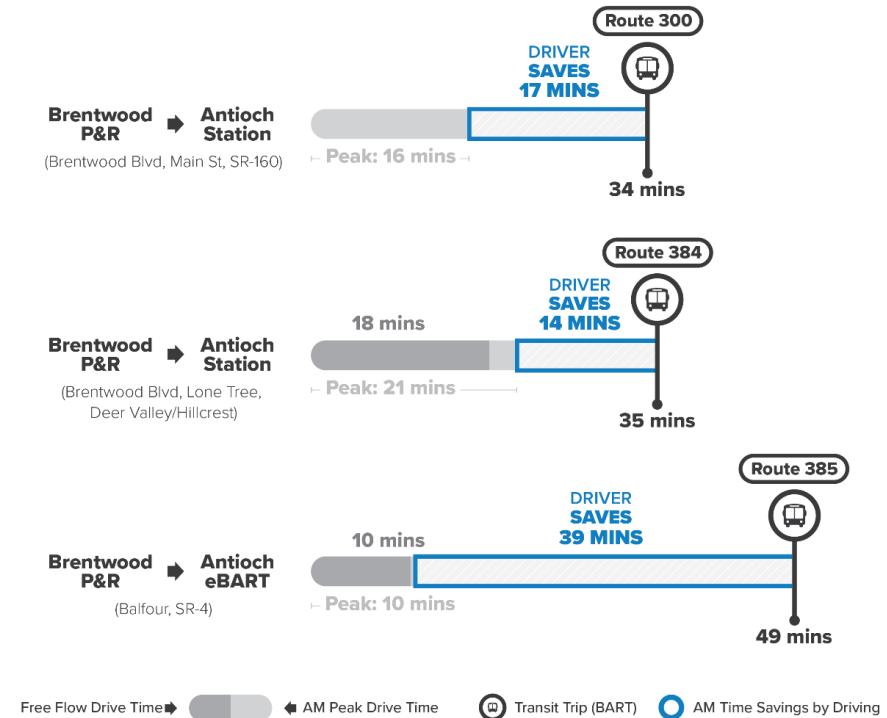
East County is served by three transit agencies. BART provides regional rail service in the greater San Francisco Bay area, ending at Antioch Station. This is a high ridership service, with trains in East County arriving every 15-20 minutes depending on time of day and day of week. All East County regional stations provide parking, however, lack any significant bicycle infrastructure.

Tri Delta Transit operates local bus lines that serve Antioch, Pittsburg, Brentwood, Oakley, and Bay Point. Tri Delta is utilized as a “Bus to BART” connection and provides services to the community including park and rides in Brentwood and Oakley, and Tri MyRide, an on-demand shuttle service for users in lower density areas to request trips.

Amtrak San Joaquin's operates from Bakersfield to Stockton where the route splits to Sacramento or Oakland. County Connection Route 93X is an express bus that operates three morning commuter trips from Antioch to Walnut Creek BART via Kirker Pass and four evening commute trips in the reverse direction. Ferry service in the Bay Area is provided by the Water Emergency Transportation Authority that operates multiple routes under the San Francisco Bay Ferry system. The agency's long-range expansion projects include an Antioch Ferry with an intermediate stop in Martinez.

Fixed route bus service diverges farther east and south of the Antioch Station along the SR-4 corridor to provide coverage among East County communities. Consequently, residents nearer to Brentwood have less access to reliable fixed routes serving the regional rail station. Driving to Antioch Station is currently faster than any transit route, which is why the BART parking lots are full early in the morning; Antioch station typically by 6am, with the Pittsburg Center and Pittsburgh/Bay Point stations by 8am.

Existing Transit and Auto Travel Times – Brentwood P&R to Antioch Station

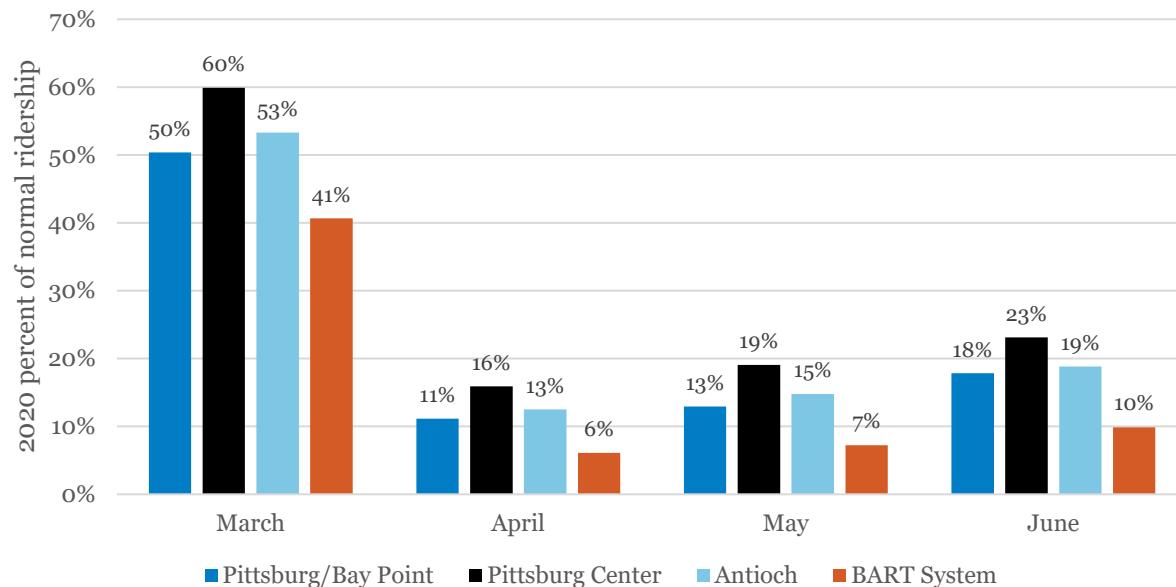


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Despite the longer transit trip time from Brentwood to Antioch, the drive time impacts of severe congestion to regional job centers along SR-4 make the combined transit trip generally competitive with auto. The extension of HCT service beyond the Antioch station to Brentwood would provide an opportunity for Brentwood commuters and transit riders to save a lot of time on longer trips to Central County and Inner Bay.

COVID-19's spread in California has had an enormous impact on the economy, travel, and many other aspects of life. The duration of shelter in place and the long-term effects of the disease are still to be determined. Starting in March, Bay Area counties issued shelter in place orders and businesses that could shift work to remote settings implemented 'work from home' operations.

The reduced travel demand and service has resulted in severe ridership drops with BART seeing a 90% drop in average daily riders through June 2020. In East County, however, all three stations continued to have proportionally more riders than the BART System as a whole. 2020 average weekday ridership as a percentage of 2019's ridership. East County transit riders may include more transit dependent and/or essential workers than the rest of the BART service area, highlighting the importance of HCT to the area.



4 ENGAGEMENT

The ECITS developed a Community Engagement Plan as an implementation roadmap for community and stakeholder outreach, including both engagement and communication strategies. Community and stakeholder input was used to develop the study vision, criteria for evaluating options, and various alternatives for what an integrated high-capacity transit network in East County could look like.

Goals and objectives for this study plan reflect a range of community engagement levels for different study milestones and decisions.

- **Inform** - Community members and stakeholders are aware of the study, CCTA's role in it, progress made throughout the study, and how to engage in the study.
- **Consult** - Community members and stakeholders share feedback on the study vision and goals, evaluation criteria and alternatives developed during the study, and the study team shares how feedback is used.
- **Involve** - Stakeholders work with the study team to finalize the community engagement plan and identify the locally preferred alternative. The study team shares how feedback is used.
- **Collaborate** - The study team partners with the stakeholders to develop the study vision, evaluation criteria, and draft alternatives together.

APPROACH

The ECITS process was conducted through four (4) phases, described below. The community and stakeholder engagement strategy was implemented during phases 1 through 3.

7. **Discovery**. Collect input to develop and refine the study vision and goals.
8. **Develop** details. Develop alternatives and evaluation criteria based on vision and goals.
9. **Decision** making. Refine and evaluate alternatives to identify potential benefits and impacts to inform selection of an LPA.
10. **Design and Delivery**. Prepare a conceptual design, cost estimates, and implementation recommendations for the LPA.

During each of the first three phases, the project team developed materials to demonstrate the attributes, potential performance benefits and tradeoffs of the study alternatives and engage with community members and stakeholders to understand their input and guide the next phase of work.

Evaluating opportunities for near and long-term transit improvements required close coordination between communities, stakeholders, CCTA staff, TRANSPLAN, and the CCTA Board. Generally, the development and decision-making process for the key decisions described in the Overview section involves the organizations and steps shown in the diagram to the right.

Two standing committees – a Technical Advisory Committee (TAC) comprised of staff representatives from East County stakeholder agencies; and a Steering Committee (SC) made up of agency leaders, managers, and department heads -- were assembled to advise the ECITS process and provide feedback at key junctures of the project. Their input was critically important to the development of public facing materials leading up to public engagement Rounds 1 through 3. They also provided context and recommendations towards incorporating community feedback immediately following each round of engagement.



The study team emphasized the following elements in initial planning conversations, which guide the community engagement strategy:

- Transparency, to build trust with communities, awareness of CCTA's role as an agency, and so that communities understand when they can participate in the study and how their input will be used.
- Simple and actionable feedback mechanisms, to make it easier for people to participate when they have limited time.
- Flexibility, to account for changing COVID-19 restrictions, individual decisions related to health and safety, and adapting to what we learn from communities.
- Balance between digital and non-technological tools, to engage people who access information in different ways.
- Follow-up, so that people understand how their suggestions and input contributed to decisions.

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The ECITS team developed a detailed suite of engagement and communication tools to provide options from which to accomplish the community engagement goals and objectives, including but not limited to:

- Briefings (small group)
- Committee meetings and presentations (Steering and Technical Advisory)
- Electronic newsletter
- Fact sheets
- Frequently asked questions (FAQs)
- Key messages
- Online Open Houses and comment forms
- Postcards
- Press releases
- Social media ads
- Tabling events

Tools were used to help the project team iterate strategic messaging as they learned from the community and stakeholder feedback. All tools, especially those requiring in-person interactions, were not able to be used or required augmentation due to ever-changing public health conditions during the COVID-19 pandemic.

ENGAGEMENT FEEDBACK

Round 1 outreach and engagement took place from October 2020 to February 2021. The objectives of the outreach effort were to educate the community members about the draft ECITS purpose and goals, as well as share feedback on the travel needs of community members. Engagement was conducted in a fully virtual environment, utilizing the CCTA website and ECITS Online Open House (OOH) portal at www.eastcountytransit.com to post findings from existing conditions and assessment of previous plans and studies. The OOH received over 1,300 visits and resulted in 250 survey responses.

Survey questions were focused on identifying the demographics, physical location, traveling habits, desires/concerns regarding high-capacity transit and land use in East County. Nearly 90% of respondents (219 out of 250) indicated they live in East County. The top five zip codes for respondents were all in East Contra Costa County and included: (91 from 94561 in Oakley, 54 from 94513 in Brentwood, 19 from 94509 in Antioch, and 17 from 94565 in Pittsburg). Respondents also provided preferential feedback on the draft ECITS Goals, by selecting their top three priorities out of six. Overall, respondents ranked the options in the following order, from highest to least priority.

1. Improve rider experience
2. Allow for future, innovative transit options
3. Support economic development
4. Respond to equitable access needs
5. Improve air quality
6. Communicate benefits of transit

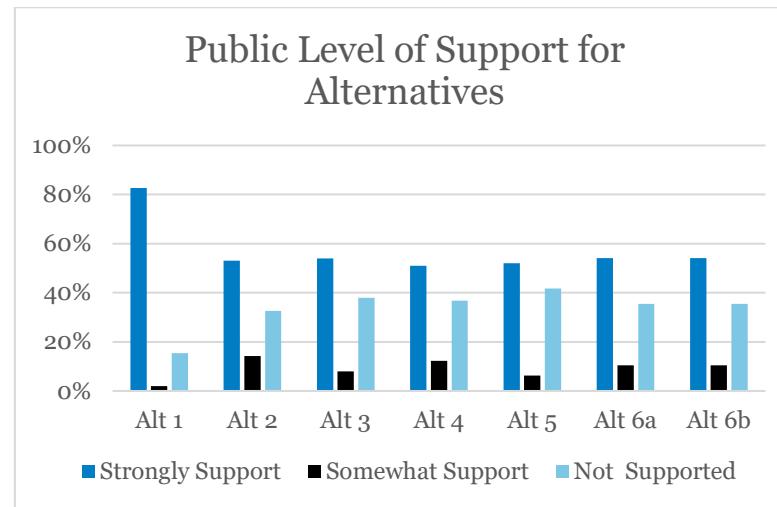
Round 2 community engagement took place between August and September 2021. The purpose of engagement during this period was to inform community members and regional stakeholder about the final six (6) HCT Alternatives considered during the Phase 3 detailed evaluation. Maintaining an all-virtual engagement environment, the OOH and CCTA website were updated to incorporate detailed 1-page overviews of each of the final alternatives which included discussion of potential operating and performance benefits and constraints as well as a set of conceptual renderings to illustrate the differences in station configuration and connectivity (dependent upon each of the Alternative in question). Refer to the *ECITS Definition of Alternatives Memorandum August 2021* for further information.

Survey questions specific to each alternative were asked of respondents to determine the relative level of support ("yes," "no," or "somewhat") garnered by each alternative. All six alternatives received higher than 50% "yes" responses and, with the BART rail extension receiving over 80% and bus alternatives receiving between 51% and 54% approval, respectively. Feedback was directly incorporated within Alternative evaluation results.

The survey also asked participants to answer how important each of the following criteria was to them. The following order, from highest to lowest, indicates the criteria which received the most percentage of "very important."

- | | |
|--|--|
| 1. Future rail extension (83.3%) | 8. Emissions reduction potential (60%) |
| 2. Travel time savings (82.4%) | 9. Transportation costs (57.1%) |
| 3. Transfers (80%) | 10. Dedicated transit right-of-way (55.6%) |
| 4. Quality of access (74.3%) | 11. Community preferred solution (48.6%) |
| 5. Transit ridership potential (73.5%) | 12. Time to implement (47.2%) |
| 6. Capacity on roadway (71.4%) | 13. Compatibility with local and regional planning (44.4%) |
| 7. Flexible service (69.4%) | 14. Cost effectiveness (38.9%) |

Round 3 of engagement took place between November 2021 and January 2022, following completion of the detailed evaluation of alternatives and concurrent with the LPA selection process. The purpose of this round of engagement was to share the results of the study – how the



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evaluated alternatives compared, and which ones rose to the top. The summarized evaluation findings as well as next steps regarding LPA selection and conceptual design were presented to the public through the updated OOH portal. Questions and open-ended responses were collected from community members through the January engagement window, with no significant objections or concerns received.

Summary results of ECITS community and stakeholder engagement rounds one through three are provided below. Refer to the (respective) *ECITS Community Engagement - Round 1, Round 2, and Round 3 – memoranda (March 2021, October 2021, February 2022)*.

5 ALTERNATIVE DEVELOPMENT

PRELIMINARY ALTERNATIVES

Implementation of HCT service within East County, along the SR-4 corridor, may take a variety of potential forms. Possible HCT solutions may include a number of permutations of zero-emission vehicle (mode) types; alignment, station spacing, and terminal station locations; as well as transit-only guideway accommodations. The process for developing preliminary HCT solutions included several iterative steps to identify opportunities and appropriate capital or service operating components to address ECITS goals and objectives, including:

- **Mode technology selection** - considers the type of bus or rail HCT vehicle that will operate the transit service, as well as maintenance and storage facility (MSF) considerations and requirements. HCT modes considered will meet the California Air Resource Board (CARB) definition of Zero-Emission Vehicle (ZEV).
- **HCT guideway configuration** - HCT service often maintains competitive reliability and travel time performance through preserving a transit-only space for vehicles to operate outside of potentially congested auto traffic conditions. Alternatives considered existing SR-4 and transit service conditions that may influence the ability to accommodate transit-only operations.
- **Alignment and Station identification** - includes potential station platform location and configuration, as well as vehicle circulation options utilizing existing or planned roadways. Alternatives operating along SR-4 did not assume to serve any intermittent stations between the existing Antioch BART station and future site of Innovation Center @ Brentwood. However, alternatives proposed to operate along arterial roadway consider infill station placement where appropriate.



Alternative to driving on the State Route 4 corridor must provide a fast, frequent, and cost effective connection from the Antioch Station, near Hillcrest Avenue, to the Innovation Center @ Brentwood, between Lone Tree Way and Sand Creek Road. Since we cannot purchase the Mococo rail line, we cannot evaluate it in this study.



The alternative to driving the State Route 4 corridor must attract high quality jobs and support economic development in East County.



Any transit alternative we evaluate or propose must be powered by electricity and not gas.



The study must consider how easily people can get to, from and use the transit alternative.



Compare potential travel times and reliability among alternatives to traditional auto trips.



Consider the needs of transit agencies responsible for operating and connecting to the alternative.



The needs of communities and stakeholders - people like you - and the mobility barriers you may face. Some people have faced systematic oppression because of race, native language, gender, sexuality, income, age, and physical ability. It is really important for us to understand as many needs and barriers as possible so we can help improve the system for everyone.

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Figure 3 | ECITS Potential HCT Modes and Characteristics

Mode	Zero Emission Vehicle Type*	Transit-Only Operations	Capacity & Construction Cost	Stop Spacing/Distance	Frequency
BUS RAPID TRANSIT 	ELECTRIC BATTERY Electric motor rechargeable at docking ports and charging stations	RAPID BUS ON LOCAL STREETS Operates in mixed traffic on local roadways			 Every 10 to 20 mins
	HYDROGEN FUEL CELL Electric motor powered by a refillable Hydrogen fuel tank	RAPID BUS ON FREEWAY Operates in its own bus-only lane within freeway right-of-way			 Every 10 to 20 mins
		EXPRESS BUS May operate in mixed traffic or managed (high-occupancy vehicle [HOV], or toll) lanes			 Every 20 mins
COMMUTER RAIL TRANSIT 	ELECTRIC HYBRID Locomotive engine powered by electric multiple unit battery, or overhead contact wire system Electrical charging stations or substations required	Operates exclusively on rail within transit and freight-only right-of-way, separate from auto lanes		 	 Every 15 to 20 mins
RAIL 	TRACTION POWER Electrified rail cars powered by rail system and supported by electrical substations	Operates exclusively on rail within transit and freight-only right-of-way separate from auto lanes, on an overhead structure, or in a tunnel		 	 Every 7 to 20 mins

* Caltrans, who provided the grant for this study, requires all alternatives to use zero-emission/electric transit vehicles.

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The preliminary alternatives considered all feasible combinations of HCT mode technology, guideway, alignment solutions serving trips between the site of the future Innovation Center @ Brentwood and existing Antioch BART station, include route alignments that may extend service west, beyond the Antioch station.

Eleven (11) preliminary alternatives, as shown Figure 4, were carried into a fatal flaw assessment. Factors and criterion used to assess the potential opportunities, constraints, and suitability of alternatives as well as potential operational and performance tradeoffs were based on the goals and objectives identified in Chapter 2.

Figure 4 | ECITS Preliminary Alternatives

ID.	Guideway	Western Termini	Eastern Termini	Mode
R-1	Dedicated Guideway in the SR-4 Median	Antioch Station: SR-4 Median Platform	Innovation Center @ Brentwood: SR-4 Median Platform	Rail (Battery-Electric EMU)
R-2	Dedicated Guideway in the SR-4 Median	Antioch Station: SR-4 Median Platform	Innovation Center @ Brentwood: SR-4 Median Platform	Rail (OCS / EMU hybrid)
R-3	Dedicated Guideway in the SR-4 Median	Antioch Station: SR-4 Median Platform	Innovation Center @ Brentwood: SR-4 Median Platform	Rail (DMU)
BRT-1	Dedicated Guideway in the SR-4 Median	Antioch Station: SR-4 Median Platform	Innovation Center @ Brentwood: SR-4 Median Platform	Zero-Emission Bus
BRT-2	Dedicated Guideway in the SR-4 Median	Antioch Station: (new) Direct Connection to Existing Bus Bays	Innovation Center @ Brentwood: SR-4 Median Platform	Zero-Emission Bus
BRT-3	Dedicated Guideway in the SR-4 Median	Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays	Innovation Center @ Brentwood: SR-4 Median Platform	Zero-Emission Bus
BRT-4	Dedicated Guideway in the SR-4 Median and Existing SR-4 General Purpose Lanes	Antioch Station: Arterial Circulation to Existing Bus Bays	Innovation Center @ Brentwood: SR-4 Median Platform	Zero-Emission Bus
EB-1	Existing SR-4 General Purpose Lanes	Antioch Station Arterial Circulation to Existing Bus Bays	Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays	Zero-Emission Bus
EB-2	Existing SR-4 General Purpose Lanes and Existing SR-4 HOV Lanes	Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays	Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays	Zero-Emission Bus

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ID.	Guideway	Western Termini	Eastern Termini	Mode
RB-1	Arterial Roadway General Purpose Lanes	Antioch Station: Arterial Circulation to Existing Bus Bays	Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays	Zero-Emission Bus
RB-2	Arterial Roadway General Purpose Lanes	Pittsburg/Bay Point Station: Arterial Circulation to Existing Bus Bays	Innovation Center @ Brentwood: Arterial Circulation to new Bus Bays	Zero-Emission Bus

R - Rail Alternative

BRT - Freeway BRT Alternative

EB - Express Bus Alternative

RB - Rapid Bus (Arterial BRT) Alternative

The types of guideways and supporting infrastructure required for each alternative were assessed to determine how they fit within the existing infrastructure. Commuter rail between Antioch and Brentwood requires the addition of a dual track in the median of SR-4 and new bridges at Lone Tree Way and Contra Costa Canal. Freeway bus rapid transit (BRT) alternatives include either the addition of a transit only lane in the SR-4 median or utilizing the existing HOV lanes for express buses. Alternatives proposing the addition of the transit only lane in the median require widened or completely new bridges at Lone Tree Way and Contra Costa Canal. Alternatives proposing arterial rapid buses are routed on arterial roads as opposed to SR-4.

Various rail and bus station configurations are analyzed with each alternative between Brentwood, Antioch, and Pittsburg/Bay Point. A median station at Brentwood can serve rail or median BRT services and requires vertical circulation, and extra connections for accessibility.

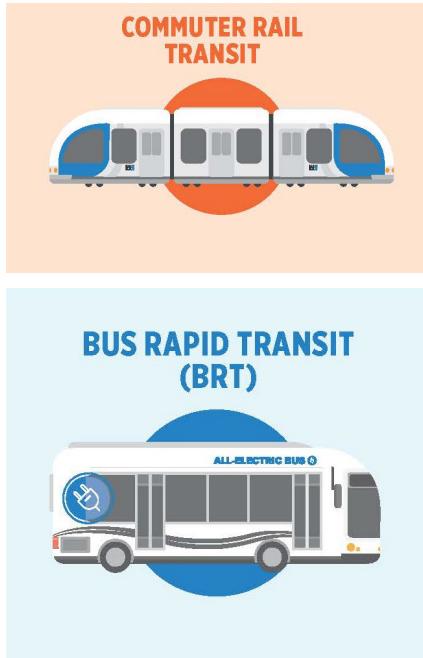
Alternatives using arterial or express buses in the existing SR-4 lanes will use the future Innovation Center @ Brentwood as a station and turnaround point. A median station at Antioch is only utilized by a commuter rail, where eBART will tie into the existing Antioch BART station and continue southbound to Brentwood. At Antioch Station, median BRT options that are separated by SR-4 GP traffic may either stop at Antioch Station or bypass it and continue northbound. To avoid requiring buses to merge across 4 lanes of traffic, alternatives propose either a flyover option or tunnel option to exit the median and serve Antioch Station. Alternatives wishing to bypass Antioch Station, continuing northbound will require an opening in the separated median to enter GP lanes. These alternatives propose serving the existing Pittsburg/Bay Point station, utilizing the existing SR-4 lanes, Hillcrest exit, and roadway network to route to the station.

Refer to Chapter 9 for additional discussion of Fatal Flaw Assessment factors and results.

FINAL ALTERNATIVES

Six (6) refined alternatives advanced past this screening for further evaluation as part of the ECITS. Below is a list of the six refined HCT alternatives for service between the future Innovation Center @ Brentwood to Antioch, or points further West:

Figure 5 | ECITS Refined Alternatives



1. **BART** rail extension between Brentwood and Antioch
2. **Freeway BRT** in median from Brentwood to Antioch
3. **Freeway BRT** from Brentwood to Pittsburg/Bay Point
4. **Express Bus** from Brentwood to Antioch
5. **Express Bus** from Brentwood to Pittsburg/Bay Point
6. **Rapid Bus** on arterials from Brentwood to Antioch
 - 6a. Hillcrest Alignment
 - 6b. Slatten Ranch Road Alignment

First / Last Mile station connectivity recommendations developed separately

Alternative 1: Commuter Rail in SR-4 Median from Innovation Center @ Brentwood to Antioch BART Station

Formerly R-1, Alternative 1 extends existing eBART commuter rail service in the SR-4 median from the existing Antioch Station to a proposed station at the Innovation Center @ Brentwood. Both BAT and SR-4 were built to allow future rail expansion. Additional train sets required to operate the service would be battery-electric EMUs, integrating into a mixed fleet with the existing diesel-powered rail train sets.

Construction is not anticipated to disrupt existing BART service between Antioch and Pittsburg/Bay Point. The future station platform at the Innovation Center @ Brentwood would be located in the median of SR-4, south of the future Mokelumne Trail Bicycle/Pedestrian Overcrossing. This alternative would support one-seat ride (no transfer required) from the future Innovation Center @ Brentwood to the BART Pittsburg/Bay Point Station.

Rail has higher passenger capacity and ridership potential but takes longer to design and construct (8-10+ years).

New rail-only bridges in the median of SR-4 may need to be built to comply with vehicle weight and clearance requirements. If bridge widening were implemented in support of bus-only lanes or HOV lanes through grade separated areas in the near-term, structures would not be adequate to support future rail. Additional costs would be incurred to accommodate new bridge infrastructure supportive of rail. New charging facilities that can support electric train sets would also need to be constructed.

Alternative 2: Freeway BRT in SR-4 Median from Innovation Center @ Brentwood to Antioch BART Station

Formerly BRT-2, Alternative 2 proposes approximately 5.1 miles of BRT using no-emission hydrogen electric buses traveling in bus-only lanes within the SR-4 median from the existing Antioch Station to a proposed station at the Innovation Center @ Brentwood. Alternative 2 avoids traffic near SR-160 because the buses would be in bus only lanes. The emergency lane (shoulder) and ROW would be preserved. Alternative 2 may require widening of freeway bridges to maintain the number of existing lanes.

Similar to Alternative 1, the future station platform at the Innovation Center @ Brentwood would be located in the median of SR-4, south of the future Mokelumne Trail Bicycle/Pedestrian Overcrossing. Buses would access the existing bus bays at Antioch Station from SR-4 via a direct connect, by way of a fly-over structure or tunnel between the median and unimproved ROW frontage on the north side of the freeway. The direct access to Antioch Station yields potentially high construction costs.

While the proposed barrier separation between bus and auto lanes allow space for future BART rail extensions and yields faster travel times, Alternative 2 ends at Antioch, meaning that passengers wishing to travel to Contra Costa County and/or the Bay Area will be required to transfer to BART at the Antioch and Pittsburg/Bay Point stations.

Alternative 3: Freeway BRT in Median and Mixed Traffic Along SR-4 from Innovation Center @ Brentwood to Pittsburg/Bay Point BART Station

Formerly BRT-3, Alternative 3 proposes BRT using no-emission hydrogen electric buses traveling approximately 9.7 miles in existing high-occupancy vehicle lanes on SR-4 from the existing Pittsburg/Bay Point Station to the Hillcrest Avenue and 3.4 miles of bus-only lanes within the SR-4 median from Hillcrest Avenue to a proposed station at the Innovation Center @ Brentwood. Alternative 3 requires bringing buses into and out of the median by modifying lane and/or shoulder configurations east of Hillcrest Avenue. Alternative 3 avoids traffic near SR-160 because the buses would be in bus only lanes. The emergency lane (shoulder) and ROW would be preserved. Alternative 3 may require widening of freeway bridges to maintain the number of existing lanes.

Buses would also utilize barrier separated bus only lanes in the median, with space for future BART rail extensions. Alternative 3 completely bypasses Antioch and Pittsburg Center BART stations, completing its trip at the Pittsburg/Bay Point Station. Traveling northbound, buses will exit the dedicated space in the median east of Hillcrest Avenue and travel in the general purpose/HOV lanes to Bailey Road, where they will circulate via existing arterial roadways to serve Pittsburg/Bay Point Station.

While Alternative 3 supports a one seat ride from the future Innovation Center @ Brentwood to Pittsburg/Bay Point Station, it does not serve Antioch or Pittsburg Center BART stations and surrounding communities, and also requires a larger bus fleet than Alternative 2 to match the frequency of BART service. This alternative also includes transit only spaces and is rail supportive. Due to the recent BART extension from Pittsburg/Bay Point to Antioch, service would be duplicative with existing rail in this segment.

Alternative 4: Express Bus in SR-4 GP from Innovation Center @ Brentwood to Antioch BART Station

Formerly EB-1, Alternative 4 proposes express buses using no-emission hydrogen electric buses traveling in existing general-purpose lanes on SR-4 from the existing Antioch Station to a proposed station at the Innovation Center @ Brentwood. Travel times for Alternative 4 are dependent on the amount of traffic congestion on SR-4.

The Brentwood station within Alternative 4 would utilize the proposed bus transfer and intermodal center adjacent to SR-4 at the future Innovation Center @ Brentwood. Buses will use the existing arterial roadways to circulate to the bus bays and enter/exit SR-4 via Lone Tree Way. Buses will travel in the general purpose/HOV lanes and exit SR-4 at Hillcrest Ave and circulate using existing arterial roadways to access the existing bus bays at Antioch Station. Since buses in Alternative 4 use the existing travel lanes on the freeway without the need to build transit-only lanes or any additional infrastructure, this is a low-cost option and has a fast implementation time. However, Alternative 4 ends at Antioch, meaning that passengers wishing to travel to Central County and/or the Bay Area will be required to transfer to BART at both the Antioch and Pittsburg/Bay Point stations.

Alternative 5: Express Bus in SR-4 GP from Innovation Center @ Brentwood to Pittsburg/Bay Point BART Station

Formerly EB-2, Alternative 4 proposes express buses using no-emission hydrogen electric buses traveling in existing general-purpose lanes on SR-4 from the existing Pittsburg/Bay Point Station to a proposed station at the Innovation Center @ Brentwood. Travel times for Alternative 4 are dependent on the amount of traffic congestion on SR-4.

The Brentwood station and circulation for Alternative 5 is the same as Alternative 4, utilizing transit bays at the future Innovation Center @ Brentwood and circulating using existing arterials to enter/exit SR-4 at Lone Tree Way. Alternative 5 buses may use the existing HOV lanes on SR-4 west of Hillcrest Avenue, where they will exit at Bailey Road and use existing arterials to get to the bus bays at Pittsburg/Bay Point Station. Travel in existing general purpose travel lanes east of Hillcrest may leave buses susceptible to traffic congestion and longer travel times in this segment. Since buses will use existing travel lanes, this is a low-cost alternative and has a short time of implementation. While Alternative 5 is a one seat ride from Brentwood to Pittsburg/Bay Point Station, minimizing transfers, it does not serve Antioch or Pittsburg Center Stations or surrounding communities and requires a larger fleet than Alternative 4 to match the frequency of BART service. Due to the recent extension of BART from Pittsburgh/Bay Point to Antioch Station, service is duplicative in this segment.

Alternative 6: Arterial Bus Connection from Innovation Center @ Brentwood to Antioch BART Station

Formerly RB-1, Alternative 6 proposes a rapid bus service using no-emission hydrogen electric buses traveling along the existing arterial street network between Antioch Station and the planned Innovation Center @ Brentwood. Two potential routing options identified as Alternative 6a and 6b have been identified. Alternative 6a would circulate west of SR-4 via Hillcrest Avenue while Alternative 6b would circulate east of SR-4, between SR-4 and the Mococo rail line, from Hillcrest Avenue to Lone Tree Way. Slatten Ranch Road is an existing facility that terminates approximately ¼ mile north of Lone Tree Way and transitions to Shady Willow Lane south of Lone Tree Way. A potential future extension of Slatten Ranch Road north through the SR-4 / SR-160 interchange would be used to connect to the existing segment of Slatten Ranch Road that circulates through the Antioch Station. Each option may include up to one intermediate rapid bus station between the Antioch Station and the Innovation Center @ Brentwood.

Both options for Alternative 6 travel on local streets between the future Innovation Center @ Brentwood and Antioch Station. Traveling on local streets closer to neighborhoods potentially improves first/last mile connectivity, but it also increases travel times since buses are susceptible to lower speeds, intersection delays, and additional stops – which also decreases reliability. Similar to Alternatives 2 and 4, since each option for Alternative 6 ends at Antioch Station, passengers wishing to travel to central Contra Costa County and/or the Bay Area require transfers to BART at Antioch and Pittsburg/Bay point stations.

Option 6a travels on the west side of SR-4 on Hillcrest Ave from Brentwood to Antioch Station. People living west of SR-4 are already served by Tri Delta fixed routes and Tri MyRide service, while those living east of SR-4 may be less likely to use this route. This option is a low-cost option that does not require building transit-only lanes or a station in the SR-4 median. With less infrastructure investments, this option allows for a faster implementation time.

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Option 6b travels on the east side of SR-4 on a future Slatten Ranch Road connection from Brentwood to Antioch. This option may benefit communities on the east of SR-4 more than communities on the west side of SR-4, but it is also separated from Brentwood and Oakley neighborhoods by the Mococo rail line. Option 6b requires construction of a new roadway from Lone Tree Way to Laurel Road, adding cost and requiring a longer implementation timeline. This roadway provides opportunity to allocate transit-only spaces but is constrained by design challenges (i.e., constrained locations where the route would intersect SR-160), operational needs, and limited funding. Rapid bus service is also not a catalyst for funding the full construction of a new roadway, meaning this option may not align with local planning.

6 SERVICE OPERATIONS

OPERATING HOURS AND FREQUENCIES

Proposed HCT alternatives are assumed to mirror future BART rail service frequencies and hours of operation, including a minimum of 15 minutes between 5am and 7pm on weekdays and 30 minutes during weekday evenings and weekends. Annual service statistics (revenue hours and revenue miles of service) are based on 255 weekdays, 52 Saturdays and 58 Sundays and holidays (holidays are treated as Sundays).

Fleet vehicle requirements by time period are based on a cycle time that reflects the estimated route travel time and driver layover time at end-of-line (no less than 15 percent of the projected one-way travel time).

HCT VEHICLE ASSUMPTIONS

Rail Vehicles

BART currently operates a commuter rail diesel multiple unit (DMU) fleet between Pittsburg/Bay Point and Antioch stations. Any additional rail vehicles purchased to extend BART service to Brentwood or beyond, would operate a ZE commuter rail or bus vehicle in order to comply with CARB regulations.

Bus Vehicles

The proposed bus fleet for the various alternatives for the ECITS were assumed to be ZE hydrogen fuel cell buses. ZE bus vehicles would be stored and operated out of Tri Delta Transit MSF located at 801 Wilbur Avenue in Antioch. Hydrogen fuel storage infrastructure will be required for the integration of ZE hydrogen fuel cell buses. Should ECITS fleet requirements exceed the capacity of Tri Delta's existing MSF, expansion of the vehicle storage area may be required.

OPERATING ASSUMPTIONS

The ECITS assumes EMU rail vehicles will be used to extend service to Brentwood for Alternative 1. This will provide a one-seat ride from the future Innovation Center @ Brentwood to Pittsburg/Bay Point Station. The ECITS assumes that the existing eBART service at Antioch Station will not be disturbed during construction and run time calculations do not include additional recovery time at the end of the line at Brentwood.

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Freeway BRT alternatives 2 and 3 assume barrier separated median BRT service between Brentwood and Antioch stations, which have the potential to preserve space for future eBART or BART rail extensions. While the median platform used in Alternatives 1-3 at the future Intermodal Center @ Brentwood would provide equal access to communities to the east and west of the site, it also makes for a more uncomfortable waiting environment. Alternative 2 would require either a dedicated busway flyover ramp or tunnel to span the SR-4 eastbound lanes and facilitate a safe transition of buses across the multilane freeway cross section. Alternative 3 bypasses Antioch and Pittsburg Center Stations to avoid potential conflicts merging from the median to GP lanes and lane transitions to the Hillcrest interchange at Antioch station -- provide a one-seat ride to BART transfers at Pittsburg/Bay Point Station. While this alternative provides a potential duplication of service with the eBART Yellow Line between Antioch and Pittsburg/Bay Point Station, it maintains the required emergency lanes and is compatible with planned HOV lanes.

Express Bus alternatives 4 and 5 both assume vehicles will travel in the existing GP lanes, with Alternative 4 stopping at Antioch Station and Alternative 5 bypassing Antioch and Pittsburg Center Stations to provide direct express service to Pittsburg/Bay Point Station. These alternatives are low-cost options that assume no additional infrastructure investment and faster implementation. Alternatives 6a and 6b both propose buses running on the existing arterial street network. They assume an increased travel time due to intersection delays, lower speeds, and additional stops. Alternative 6a runs on the existing Hillcrest Ave on the west side of SR-4, with minimal investments to provide TSP and new vehicles. Alternative 6b assumes the full buildup of Slatten Ranch Road with reversable transit-only lanes during peak travel times. This alternative has higher investment needs and a longer constructability timeline.

The Innovation Center @ Brentwood is the end of the line for all alternatives. As noted above, alternatives 1-3 utilize a center station platform in the median of SR-4. The center platform is accessible via the Mokelumne Trail Bicycle/Pedestrian Overcrossing and requires vertical circulation to route users to the platform. Alternatives 4-6 will utilize the transit bays that are being constructed as part of the Innovation Center @ Brentwood. Antioch Station serves Alternative 1 by connecting rail at the existing median BART station. Alternatives 2, 4, and 6 use the existing bus bays at Antioch Station for the end of their service. Pittsburg/Bay Point Station serves Alternatives 3 and 5 via the existing bus bays.

FLEET REQUIREMENTS

The number of vehicles required was calculated by understanding the total run time and desired frequencies for service. The average speed of each roadway segment along the total length of each alternative was estimated using (2018) INRIX travel data and real-time trip planning and auto drive time estimation tools available online. A 2½ -minute driver recovery and layover period was also added to the estimated peak period and off-peak one-way run times.

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Figure 6 | ECITS Alternative Fleet Requirements and Estimated Revenue Hours of Service

Alternative	Peak Vehicles	Avg Weekday Rev Hrs.
Alt 1: Commuter rail in SR-4 median	1	95
Alt 2: Freeway BRT in SR-4 median (to Antioch)	2	170
Alt 3: Freeway BRT in SR-4 median (to Pittsburg/Bay Pt)	4	300
Alt 4: Express Bus in SR-4 GP (to Antioch)	2	170
Alt 5: Express Bus in SR-4 GP (to Pittsburg/Bay Pt)	5	335
Alt 6a: Arterial Bus on local streets via Hillcrest Ave (to Antioch)	3	205
Alt 6b: Arterial Bus on local streets via Slatten Ranch Road (to Antioch)	3	205

NOTE: peak vehicle requirements do not include 20% spare ratio or consider vehicle carrying capacity vs loading demands aligned with projected ridership

Preliminary ridership estimates were not complete by at the time of operations and maintenance (O&M) cost estimating; therefore, initial fleet requirement estimates did not consider the vehicle capacity constraints of proposed bus and rail alternatives in comparison with peak period ridership projections and commensurate vehicle load projections. This was particularly relevant for alternatives 2 through 5, where a single 40-foot ZE bus may have experience challenges in accommodating peak-period BART ridership demand and transfers at the existing Antioch Station.

BACKGROUND SERVICE MODIFICATIONS

The introduction of HCT service provides opportunity to restructure the underlying fixed route bus service provide in East County by Tri Delta.

Potential adjustments of the existing fixed route transit network to support HCT service between Brentwood and Antioch were not determined at the time of the ECITS study. Concurrent to the development of ECITS recommendations, Tri Delta transit was in the process of constructing a new park and ride facility in the City of Oakley and developing commensurate network modifications to address this and other changes in East County travel demand markets and patterns.

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The future fixed route network included within the CCTA Travel Demand model forecasting potential ridership of ECITS alternatives did not make any modifications to the adopted and programmed transit network in the 2040 CCTA model horizon year.

7 TRAVEL DEMAND AND RIDERSHIP

Preliminary forecasts of ridership and other measures of effectiveness are useful to determine the benefits and trade-offs of each alternative transit concept. The metrics include:

- Ridership forecasts for the new transit service as well as for three east county BART stations (Pittsburg-Bay Point, Pittsburg Center, and Antioch).
- Station service area metrics for each station on the new transit service, including population and demographics, available parking, existing and planned pedestrian and bicycle infrastructure, and potential opportunities for transit-supportive land uses and development within each station area.
- Automobile travel along the SR-4 corridor between Pittsburg and Brentwood.

Figure 7 shows ridership forecasts for the 2040 horizon year for each alternative. Figure 8 shows the reduction of vehicle miles travelled resulting from users choosing to travel via each alternative instead of traveling by personal vehicle.

Figure 7 | Ridership Results

Alternative	Daily Ridership	AM Peak Brentwood Boardings	PM Peak Brentwood Boardings
Alt 1: BART Rail Extension between Brentwood and Antioch	3,700	1,510	160
Alt 2: Freeway BRT in median from Brentwood to Antioch	780	280	80
Alt 3: Freeway BRT from Brentwood to Pittsburg/Bay Point	800	330	40
Alt 4: Express Bus from Brentwood to Antioch	770	280	80
Alt 5: Express Bus from Brentwood to Pittsburg/Bay Point	800	320	40
Alt 6a: Arterial Rapid Bus via Hillcrest Ave	250	70	10
Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd	250	70	10

Source: Fehr & Peers, 2021.

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Each of the proposed alternatives were projected to result in increased transit ridership between eastern Contra Costa County and other parts of the County (and wider Bay Area). Many of these additional trips were the result of riders choosing to not travel by personal automobile, thus resulting in a reduction in traffic congestion along the section of SR-4 from Brentwood to Willow Pass Road and regional vehicle-miles traveled (VMT). Figure 8 details the outputs of the VMT reduction calculations, which quantify the weekday daily regional VMT reduction resulting from the alternatives.

Figure 8 | Weekday Daily Regional Vehicle Miles Traveled

Alternative	Reduction of VMT
Alt 1: BART Rail Extension between Brentwood and Antioch	186,000
Alt 2: Freeway BRT in median from Brentwood to Antioch	38,000
Alt 3: Freeway BRT from Brentwood to Pittsburg/Bay Point	40,000
Alt 4: Express Bus from Brentwood to Antioch	37,000
Alt 5: Express Bus from Brentwood to Pittsburg/Bay Point	40,000
Alt 6a: Arterial Rapid Bus via Hillcrest Ave	12,000
Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd	12,000

Source: Fehr & Peers, 2021.

8 CAPITAL AND OPERATING COSTS

The capital and operating costs were developed as rough order of magnitude (ROM) costs estimates for comparative uses in the evaluation of the alternatives against each other. Upon selection of an LPA, both the capital and operating cost estimates were refined and further developed for the selected LPA.

Capital Cost Estimates

Capital costs were developed in alignment with the Federal Transit Administration's Standard Cost Categories (SCC) for the Capital Investment Grants (CIG) program. The SCC's break down project component costs into ten (10) categories including the following:

- Five (5) categories of typical infrastructure components make up the projected Construction Subtotal, including: Guideway, Stations, Facilities, Sitework & Special Conditions, and Systems
- An additional three (3) categories make up the projected Soft Cost Subtotal, including: Right-of-Way (ROW), Vehicles, and Professional Services.
- And two (2) additional categories capture potentially unanticipated costs in the projected Total Cost, including unallocated contingency and Finance Charges. (Note: Debt finance mechanisms are not assumed for this project)

Figure 8 illustrates the varying capital cost estimates between the seven (7) different alternatives. Overall project costs varied significantly among alternatives, stratified across an order of magnitude between approximately \$3 million - \$250 million. Key cost drivers and assumptions are as follows:

- Alternative 1 capital unit costs were based on the recently completed Antioch Extension (2016). The costs include constructing new rail infrastructure and vehicle purchases as well as modification to existing tail track and MSF lead tracks to enable through service to Brentwood.
- Alternative 2 included costs for construction of a dedicated BRT guideway in the median of SR-4 and required either a tunnel or flyover ramp solution to connect directly to Antioch Station. Alternative 3 transitions to GP lanes at the Hillcrest interchange and did not require the additional flyover (or tunnel) infrastructure. However, it does require additional vehicles to maintain desired frequencies.

- Alternatives 4, 5, and 6a assume minimal costs for station area improvements at the existing Antioch Station and future Intermodal Center at Brentwood (paid by other projects). Totals are primarily driven by fleet vehicle costs. Alternative 6b includes additional costs for the (unfunded) extension Slatten Ranch Road though the SR-160 interchange to provide direct connection to Antioch Station.

Figure 9 | ECITS Alternative Capital Cost Estimates (\$2019)

Standard Cost Category (SCC)	Alternative 1 Costs	Alternative 2 Costs	Alternative 3 Costs	Alternative 4 Costs	Alternative 5 Costs	Alternative 6a Costs	Alternative 6b Costs
Construction Subtotal (10-50)	\$128,580,000	\$92,583,000	\$60,548,000	\$138,000	\$138,000	\$1,100,000	\$15,348,000
Soft Costs Subtotal (60-80)	\$78,378,000	\$36,234,000	\$26,8612,000	\$2,883,000	\$5,718,000	\$4,165,000	\$9,146,000
Other (SCC 90-100)	33,113,000	21,572,000	14,703,000	571,000	1,111,000	967,000	4,170,000
Total Project Costs (10-100)	\$240,071,000	\$150,669,000	\$102,112,000	\$3,292,000	\$6,967,000	\$6,232,000	\$28,665,000

Tri Delta Transit plans to purchase and operate hydrogen fueled ZE vehicles for any of the proposed bus alternatives. Capital cost estimates for ZE bus alternatives do not include Hydrogen fuel storage infrastructure, nor expansion of the vehicle storage area to accommodate capacity constraints at Tri Delta's existing MSF.

Operations and Maintenance (O&M) Cost Estimates

Estimates of O&M costs are important considerations for Agency operators to understand the potential incremental impacts of projects to existing budgets, as well as programmed operational funding and revenues.

Order of magnitude annual O&M were calculated based on the projected amount of annual vehicle revenue hours (RHs) for each alternative, and the fully allocated average fixed route transit unit costs (per RH) from Tri Delta and BART in FY 2019. Fully allocated unit costs consider the ongoing costs to operate fixed route service for each agency (respectively) incorporating typical factors such as but not limited to operator, support and maintenance staff labor, fuel and electricity, parts and materials, overhead and administration, non-revenue vehicle and vehicle costs, insurance, facility.

Since the BART rail and BRT / Rapid Bus alternatives are all assumed to share the same operating span and frequency, estimation of annual revenue hours for each alternative shared the same methodology. Unit cost per RH provided from BART and Tri Delta Transit were \$331.00

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and \$117.91 in 2019 dollars, respectively. Refer to the *ECITS Service Operations memorandum, October 2021* for detailed operating assumptions.

Figure 10 | ECITS Alternative O&M Cost Estimates (\$2019)

Alternative	Peak Vehicles	Avg Weekday Rev Hrs.	Annual RH	Annual O&M Cost
Alt 1: BART Rail Extension between Brentwood and Antioch	1	95	25,915	\$8,578,000
Alt 2: Freeway BRT in median from Brentwood to Antioch	2	170	45,040	\$5,311,000
Alt 3: Freeway BRT from Brentwood to Pittsburg/Bay Point	4	300	79,880	\$9,419,000
Alt 4: Express Bus from Brentwood to Antioch	2	170	45,040	\$5,311,000
Alt 5: Express Bus from Brentwood to Pittsburg/Bay Point	5	335	88,805	\$10,471,000
Alt 6a: Arterial Rapid Bus via Hillcrest Ave	3	205	53,965	\$6,364,000
Alt 6b: Arterial Rapid Bus via Slatten Ranch Rd	3	205	53,965	\$6,364,000

Tri Delta Transit plans to purchase and operate hydrogen fueled ZE vehicles for any of the proposed bus alternatives. However, due to ongoing market changes in fuel prices, technological advances, and the shifts towards ZE vehicles, the potential future impact of ZE hydrogen fuel prices and vehicles on Tri Delta Transit's fully allocated O&M cost model were not factored into the estimate. Existing (2019) O&M unit costs consider only their existing electric bus fleet.

The methodology presented was used as a guide in the development of O&M costs for each alternative. It is recognized that adjustments to unit costs may be appropriate to account for alternative refinements and nuances.

9 ALTERNATIVE ANALYSIS AND EVALUATION

The purpose of the AA process was to develop reasonable set of alternatives, indicators, and criteria to equitably evaluate the comparative benefits and tradeoffs of potential solutions. The findings were communicated with the community and stakeholders for their feedback and eventual approval of an LPA.

EVALUATION FRAMEWORK

The Alternatives Analysis process included the 2-step evaluation framework to guide the development conceptual alternatives, detailed evaluation criteria and metrics to inform decision-making and set the stage for future high-capacity transit investments in East County, illustrated in Figure 9. During each step of the process, the alternatives and criterion used to assess potential benefits and impacts became progressively more detailed in granularity. The findings at each level of evaluation were used to daylight potential opportunities for refinement to assumptions for service operations, capital infrastructure and technology components.

Figure 11 | ECITS Alternative Development and Evaluation Process



The preliminary alternatives considered all feasible combinations of HCT mode technology, guideway, alignment solutions serving trips between the site of the future Innovation Center @ Brentwood and existing Antioch BART station, include route alignments that may extend service west, beyond the Antioch station. Factors and criterion used to assess the potential opportunities, constraints, and suitability of alternatives as well as potential operational and performance tradeoffs were based on the ECITS goals and objectives previously identified.

Step 1: Fatal Flaw Screening

Step 1 of the evaluation process consisted of a fatal flaw screening to discern meaningful differentiations between preliminary alternatives and qualitatively assess those most suitable for detailed refinement and evaluation during Step 2. Fatal flaw factors were mainly qualitative in

nature to gauge the relative feasibility and viability of potential solutions. The qualitative review of alternatives also served to identify which sub options may be overly disruptive or burdensome to construct or operate, operationally similar or redundant to one another, and determine an appropriately representative alternative to move forward for additional refinement.

Top rated alternatives were recommended to the community for concurrence and additional feedback prior to additional refinement for detailed evaluation.

The preliminary alternatives considered all feasible combinations of HCT mode technology, guideway, alignment solutions serving trips between the site of the future Innovation Center @ Brentwood and existing Antioch BART station, include route alignments that may extend service west, beyond the Antioch station. Developing appropriate metrics illustrating differentiators among alternatives included, but was not limited to assessing:

- How well does an Alternative meet these stated project objectives?
- Are the concerns and interests of passengers, owners, operators, stakeholders taken into account?
- What information is available and is it available across all potential Alternatives?
- Do some metrics have greater significance than others when identifying comparative benefits or impacts?

Fatal Flaw Factor	Description
	Constructability Does the option have any unique design challenges that may require highly custom infrastructure or construction equipment to install?
	Safety and Security Would any infrastructure or operating conditions create potential safety risks?
	Compatible Operations Does the option include mode technology or supporting infrastructure that create potential conflicts with existing transit service or mobility operations?
	Jurisdiction / Regulatory Compliance Does the option cause Agencies, Operators, or Users any potential conflicts with adopted laws, policies, regulations, or agreements?
	Cost Effectiveness Is there an option that can meet the same infrastructure, service, and technology components – at a much lower price and with little-to-no difference in quality?

Step 2: Detailed Evaluation

The results of the screening identified 6 conceptual alternatives (1 rail extension and 5 fixed route bus extension) that were further refined to identify appropriate transit priority capital improvements, as well as station area routing and connectivity solutions to support operations. The detailed evaluation quantitatively compared potential benefits, impacts, and performance of refined alternatives using the metrics on the metrics below.

Detailed evaluation of refined alternatives was primarily quantitative, using data-driven and performance-based estimations of service efficiency, productivity, costs, and impacts. Using results of Step 2 evaluation, the highest performing Alternatives were recommended for selection of an LPA and potential implementation. Community buy-in (level of support) for refined alternatives was also taken into consideration with the final scoring and rating of alternatives for LPA recommendation and advancement for additional development through Conceptual Design.

While final alternatives were refined to further identify capital infrastructure and service operating assumptions, additional options for the specific design of capital components or nuanced operating strategies may have been identified during the process. Design options and other special considerations were assessed in more detail during the Conceptual Design phase of this study or recommended for additional research during future phases of project development and design.

Evaluation Criteria



TRAVEL TIME SAVINGS

MEASUREMENT

What is the time spent traveling by car compared to the time spent traveling by transit from East County to various Bay Area destinations?



TRANSFERS

MEASUREMENT

How many transfers would be needed to take transit from East County to various Bay Area destinations and how easy is it to make these connections?



QUALITY OF ACCESS

MEASUREMENT

Where do commuters from Antioch, Oakley, and Brentwood live? Are the stations accessible to them?



TRANSPORTATION COSTS

MEASUREMENT

What is the cost of driving and parking compared to the cost of taking transit, which includes the price of the transit pass/ticket, and costs associated with traveling by bike, car, or micromobility to transit station?



TRANSIT RIDERSHIP POTENTIAL

MEASUREMENT

How many new riders are expected to use the planned transit service?



EMISSIONS REDUCTION POTENTIAL

MEASUREMENT

What is the potential reduction in vehicle miles travelled, carbon dioxide and other vehicle emissions?



CAPACITY ON ROADWAY

MEASUREMENT

How many people could be moved through the State Route 4 (SR-4) corridor (in East County) with the proposed transit alternatives?



COMPATIBILITY WITH LOCAL AND REGIONAL PLANNING

MEASUREMENT

How does proposed station area and SR-4 improvements align with existing plans?

Evaluation Criteria

 <h3>FLEXIBLE SERVICE</h3> <p>MEASUREMENT How flexible is the alternative to respond to potential future demands for high capacity transit connections in East County?</p>	 <h3>TIME TO IMPLEMENT</h3> <p>MEASUREMENT How long will it take to build?</p>
 <h3>DEDICATED TRANSIT RIGHT-OF-WAY</h3> <p>MEASUREMENT How much of the transit service will operate within space (lanes) designated for transit-only use?</p>	 <h3>COMMUNITY PREFERRED SOLUTION</h3> <p>MEASUREMENT Based on community and stakeholder feedback, which alternative is most popular? Which alternative is least popular?</p>
 <h3>FUTURE RAIL EXTENSION</h3> <p>MEASUREMENT Is the alternative compatible with BART median guideway design criteria?</p>	 <h3>COST EFFECTIVENESS</h3> <p>MEASUREMENT What is the cost (per new rider) of building, operating and maintaining the transit infrastructure?</p>

EVALUATION RESULTS, KEY FINDINGS & RECOMMENDATIONS

During detailed evaluation, each alternative was scored on a scale of 1 to 5 (5 being the highest score) based on comparative performance within a variety of criteria like travel time savings, VMT reduction potential, capacity, service flexibility, and cost effectiveness just to name a few. Each evaluation criterion was assigned a relative, weighted value to represent an approximate level of significance in decision making. The relative 'weights' were adjusted following Round 2 engagement feedback received from community members, based on responses related to the level of importance they felt toward each criteria category.

Key Alternative attributes and data points uncovered during evaluation are identified in Figure 12.

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Figure 12 | ECITS Alternative Evaluation Scores and Rankings

Alt	Description		Length	Daily Riders [†]	2019 Capital Cost (\$M)	Total Score	Weighted Score	Ranking
1	BART rail in SR-4 median	Brentwood to Antioch	4.3	3,700	\$240m	56	78.8	1
2	Freeway BRT in SR-4 median	Brentwood to Antioch	5.1	780	\$151m	42	60.4	4
3	Freeway BRT in SR-4 median	Brentwood to Pitt/Bay Pt	14.3	800	\$102m	41	59.4	5
4	Express Bus in SR-4 travel lanes	Brentwood to Antioch	5.2	770	\$3.6m	45	67.2	2
5	Express Bus in SR-4 travel lanes	Brentwood to Pitt/Bay Pt	14.2	800	\$7.0m	42	62.8	3
6a	Rapid Bus on Lone Tree / Hillcrest	Brentwood to Antioch	4.6	250	\$5.2m	39	57.8	6
6b	Rapid Bus on Slatten Ranch	Brentwood to Antioch	4.8	250	\$28.7m	34	49.2	7

† - Horizon year 2040 ridership forecasts based on Plan Bay Area 2040 land uses, with adjustments to TAZs for planned residential and commercial development at the Innovation Center @ Brentwood

A summarized, 3-tier rating of alternative performance among the six ECITS project Goals (composite of the 14 evaluation criteria) is illustrated in Figure 13. Refer to the *ECITS Alternatives Evaluation Memorandum, December 2021*, for further information and results for individual criterion.

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Figure 13 | ECITS Detailed Evaluation Summary (by Goal)

Alternative	Description	From Brentwood to:	Study Goals					
			User Experience	Equitable Access	Improve Air Quality	Economic Development	Future Transit Investments	Communicate Benefits and Tradeoffs
1	 BART rail in SR 4 median	Antioch						
2	 Dedicated BRT in SR 4 median	Antioch						
3	 Dedicated BRT in SR 4 median	Pitt/Bay Pt						
4	 Express Bus in SR 4 travel lanes	Antioch						
5	 Express Bus in SR 4 travel lanes	Pitt/Bay Pt						
6a	 Rapid Bus on Lone Tree/Heidom	Antioch						
6b	 Rapid Bus on Slatten Ranch	Antioch						

10LPA SELECTION AND APPROVAL

LPA SELECTION

Top Performing Alternatives

In recommendation of the LPA, the study considered both of the top two performing alternatives, the BART rail extension between Brentwood and Antioch and the Express Bus from Brentwood to Antioch. In addition to being the top two performing alternatives in the analysis, they also represent the bookends of the near- and long-term extents for implementation time and costs to implement.

While the BART rail extension between Brentwood and Antioch has a reduced travel time, increased ridership, capacity, and emissions reduction, and is compatible with a future rail extension, it has a significantly longer implementation timeline, higher costs, and requires additional station area density at the Innovation Center @ Brentwood to justify BART rail extension as well as have access to regional discretionary funds.

The Express Bus from Brentwood to Antioch is lower cost, has a shorter implementation timeline and provides near-term service flexibility and future extension opportunities, however it is anticipated to have lower ridership, carrying capacity, travel time benefits, and emissions reduction. While not precluding the potential for future rail investment, it also does not preserve dedicated space for transit.

Identification of the Locally Preferred Alternative

Per the scope of work included in the Caltrans Sustainable Communities Planning Grant, the project “intends to identify a near-term solution for providing transit service between Antioch and Brentwood, while retaining the possibility of a future extension of BART to Brentwood in the long-term.”

In comparing the top two performing alternatives, the Express Bus from Brentwood to Antioch was recommended for adoption as the Locally Preferred Alternative, as it best met the intent of study to identify “a near-term solution” based on the design and construction timeline. In addition to the longer timeline required for design and construction for the BART rail extension between Brentwood, the higher capital costs and incompatibility with regional land use policy and resulting lack of access to regional discretionary funding will result in a significantly longer timeline to implementation for the BART rail extension between Brentwood.

As such, the Express Bus from Brentwood to Antioch was recommended for adoption at the Locally Preferred Alternative for near-term implementation, while the BART rail extension between Brentwood was recommended for consideration as a longer-term option, pending

future land use and density changes. For more details on the selection of the LPA and access to regional discretionary funds, refer to the *Locally Preferred Alternative Selection Memo, January 2022*.

LPA APPROVAL

A series of review and approval meetings were held to present and discuss the top performing alternatives, the existing land use policies, and the recommendation of the Express Bus from Brentwood to Antioch as the Locally Preferred Alternative. A list of these meeting can be found in Figure 14.

Figure 14 | LPA Recommendation Meetings and Presentations

Date	Meeting / Presentation
November 17 th , 2021	TRANSPLAN Committee Meeting
December 1 st , 2021	CCTA Planning Committee Meeting
December 9 th , 2021	BART Staff Meeting
December 13 th , 2021	Tri Delta Transit Staff Meeting
December 15 th , 2021	CCTA Board Meeting

During the CCTA Board Meeting on December 15th, the CCTA Board approved the motion to approve the recommendation of the Locally Preferred Alternative “for Alternative 4 Express Bus to Antioch as recommended in the study and move it to cost refinement and conceptual design, and advancing certain design elements of the higher cost Alternative 1 Bay Area Rapid Transit Rail Extension” by a vote of 8-0, with three (3) commissioners absent.

11 CONCEPT DEVELOPMENT AND REFINEMENT

Per the direction of the CCTA Board, both the LPA of the Express Bus from Brentwood to Antioch and the (top performing, but longer term) alternative of the BART rail extension between Brentwood and Antioch were advanced in the concept development and refinement phase of the ECITS project. This process resulted in conceptual plans for infrastructure improvements needed for both alternatives, as well as

refinements to the cost estimates based on additional information obtained since the evaluation phase of the study and on new information identified through the concept design process. For more information on the concept design methodology, conceptual design plans, and revised cost estimates, please refer to the *ECITS Concept Design Report, February 2022*.

CONCEPTUAL DESIGN REFINEMENTS

Conceptual design plans were developed for both top performing alternatives to identify potential constraints and opportunities for transit priority guideway as well as station area connectivity and circulation considerations and can be found in the *ECITS Concept Design Report*.

Alternative 4: Express Bus from Brentwood to Antioch

For Alternative 4, the concept design included a layout for a proposed transit center at the Innovation Center @ Brentwood (funded by others), bus only lanes for the eastbound travel direction from Antioch to Brentwood, on westbound Slatten Ranch Road, southbound Hillcrest Avenue, and the eastbound on-ramp to SR-4, and a bus storage facility located at Wilbur Avenue and Apollo Court. It is assumed that the existing bus bays at the Antioch Station have the required capacity for the express bus service.

Based on the established peak period commuter patterns in East County and vehicle carrying capacity differential between BART DMU vehicles and Tri Delta ZE buss, Tri Delta Transit recommended operating Express Buses at an increased target frequency during the peak periods (approximately every 5 to 8 minutes) to provide the additional capacity required to accommodate passenger loads and demand. Based on the increased fleet requirements so support more frequent service (in addition to Hydrogen fueling and storage facilities), Tri Delta Transit identified the need to expand the vehicle storage facility at located at 801 Wilbur Avenue in Antioch.

Refined capital cost estimates for ZE bus alternatives do not include Hydrogen fuel storage infrastructure, nor expansion of the vehicle storage area to accommodate capacity constraints at Tri Delta's existing MSF.

Alternative 1: BART rail extension between Brentwood to Antioch

For Alternative 4, the concept design included a basis of design for rail infrastructure, modifications to the trail track at the Antioch station, widening of SR-4 to accommodate rail transit in the median, rail alignment design from Antioch to Brentwood, and a rail station footprint at Brentwood, consistent with the existing BART station at Pittsburg Center.

UPDATES TO COST ESTIMATES

The conceptual design process gave the project team a second chance to dive deeper in the assumptions made to the initial rough-or-of-magnitude costs previously calculated for the purposes of evaluation and comparison of alternatives and identify refinements that provide an updated estimates for the top performing alternatives. While the following revisions increase the costs of Alternatives 1 and 4, they do not change the order of magnitude of the and would not have changed the outcome of the evaluation process.

Figure 15 ECITS LPA Alternative 4: Capital Cost Estimate Differentials (nearest \$000)

Standard Cost Category (SCC)	Alternative Evaluation Cost	LPA Costs
SCC 10: Guideway & Track Elements	\$0	\$1,028,000
SCC 20: Stations, Stops, Terminals, Intermodal	\$0	\$0
SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs.	\$0	\$3,083,000
SCC 40: Sitework & Special Conditions	\$18,000	\$367,000
SCC 50: Systems	\$120,000	\$120,000
Construction Subtotal (10-50)	\$138,000	\$4,598,000
SCC 60: ROW, Land, Existing Improvements	\$0	\$0
SCC 70: Vehicles	\$2,835,000	\$4,725,000
SCC 80: Professional Services	\$48,000	\$1,609,000
Soft Costs Subtotal (60-80)	\$2,883,000	\$6,334,000
SCC 90: Unallocated Contingency	\$571,000	\$1,575,000
SCC 100: Finance Charges	\$0	\$0
Total Project Costs (10-100)	\$3,592,000	\$12,866,000

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Figure 16 Alternative 1: Capital Cost Estimate Differentials (nearest \$000)

Standard Cost Category (SCC)	Alternative Evaluation Cost	LPA Cost
SCC 10: Guideway & Track Elements	\$62,400,000	\$69,400,000
SCC 20: Stations, Stops, Terminals, Intermodal	\$10,400,000	\$10,400,000
SCC 30: Support Facilities: Yards, Shops, Admin, Bldgs.	\$12,500,000	\$12,500,000
SCC 40: Sitework & Special Conditions	\$21,830,000	\$21,830,000
SCC 50: Systems	\$21,850,000	\$21,850,000
Construction Subtotal (10-50)	\$128,580,000	\$136,980,000
SCC 60: ROW, Land, Existing Improvements	\$0	\$0
SCC 70: Vehicles	\$33,375,000	\$33,375,000
SCC 80: Professional Services	\$45,003,000	\$47,943,000
Soft Costs Subtotal (60-80)	\$78,378,000	\$81,318,000
SCC 90: Unallocated Contingency	\$33,113,000	\$34,927,900
SCC 100: Finance Charges	\$0	\$0
Total Project Costs (10-100)	\$240,071,000	\$253,228,000

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Figure 17 ECITS LPA O&M Cost Estimate Differentials

Alternative	Alternatives Evaluation			LPA Concept Design		
	Peak Vehicles	Annual Rev Hrs.	Annual O&M Cost	Peak Vehicles	Annual Rev Hrs.	Annual O&M Cost
Alt 1: Commuter rail in SR-4 median	1	25,915	\$8,578,000	1	25,915	\$8,578,000
Alt 2: Freeway BRT in SR-4 median (to Antioch)	2	45,040	\$5,311,000	--	--	--
Alt 3: Freeway BRT in SR-4 median (to Pittsburg/Bay Pt)	4	79,880	\$9,419,000	--	--	--
Alt 4: Express Bus in SR-4 GP (to Antioch)	2	45,040	\$5,311,000	4	57,790	\$6,815,000
Alt 5: Express Bus in SR-4 GP (to Pittsburg/Bay Pt)	5	88,805	\$10,471,000	--	--	--
Alt 6a: Arterial Bus on local streets via Hillcrest Ave (to Antioch)	3	53,965	\$6,364,000	--	--	--
Alt 6b: Arterial Bus on local streets via Slatten Ranch Road (to Antioch)	3	53,965	\$6,364,000	--	--	--

APPENDICES

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ALTERNATIVE 1

BART from Brentwood to Antioch

Extend BART commuter rail service in the State Route 4 (SR-4) median from the future Innovation Center @ Brentwood Station to the existing Antioch Station.

Overview



- Extension of existing BART rail with compatible stations. BART and SR-4 were built to allow for future expansion.
- New electric* train sets would operate in mixed fleet with existing diesel-powered train sets.
- Construction is not anticipated to disrupt existing BART service between the Antioch and Pittsburg / Bay Point stations.

Details

- Supports one-seat ride (no transfer required) from the future Innovation Center @ Brentwood Station to the BART Pittsburg / Bay Point Station.
- Development densities in East County do not currently meet thresholds required for BART rail extension to Brentwood.
- Station platform in the median of SR-4 at the future Innovation Center @ Brentwood, provides equal access to communities east and west of SR-4 via future Mokelumne Trail Bicycle/Pedestrian Overcrossing.
- Rail has higher passenger capacity and ridership potential but takes longer to design and construct (8 – 10+ years).
- New rail-only bridges in the median of SR-4 may need to be built to comply with vehicle weight and clearance requirements.
- New charging facilities that can support electric* train sets would also need to be built.

Potential Benefits



Shorter Travel Time



Less Transfers



Move More People



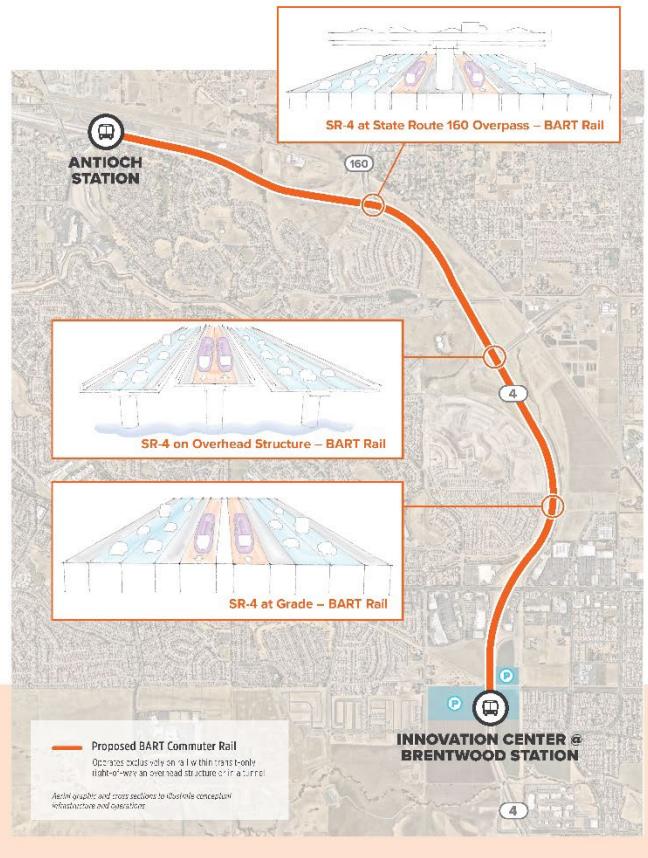
Longer Time to Implement



Not Aligned with Regional Planning

To learn more about this and all other alternatives, visit eastcountyttransit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.



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ALTERNATIVE 2

Bus Rapid Transit in Median from the Future Innovation Center @ Brentwood to Antioch

Build new bus-only lanes in the State Route 4 (SR-4) median from the future Innovation Center @ Brentwood Station to the existing Antioch Station.

Overview



- Bus rapid transit using no-emission, hydrogen electric* buses traveling in bus-only lanes within the freeway median, and with direct access to the Antioch Station.
- Avoids traffic near State Route 160 (SR-160), because the buses will be in median bus-only lanes. The emergency lane (shoulder) and right-of-way would be preserved.
- May require widening of freeway bridges to maintain number of existing lanes.

Details

- Station platform in the median of SR-4 at the future Innovation Center @ Brentwood provides equal access to the east and west of SR-4 via future Mokelumne Trail Bicycle / Pedestrian Overcrossing.
- Barrier separation between bus and auto lanes where feasible between Sand Creek Road and SR-160 preserves space for future BART rail extension, if needed.
- Potentially high construction cost to bring buses into and out of the median for direct access to the BART Antioch Station. This would require construction of a new flyover bridge or tunnel west of the SR-160 interchange.
- Transit trips to central Contra Costa County and/or the Bay Area require transfers to BART at the Antioch and Pittsburg / Bay Point stations.

Potential Benefits

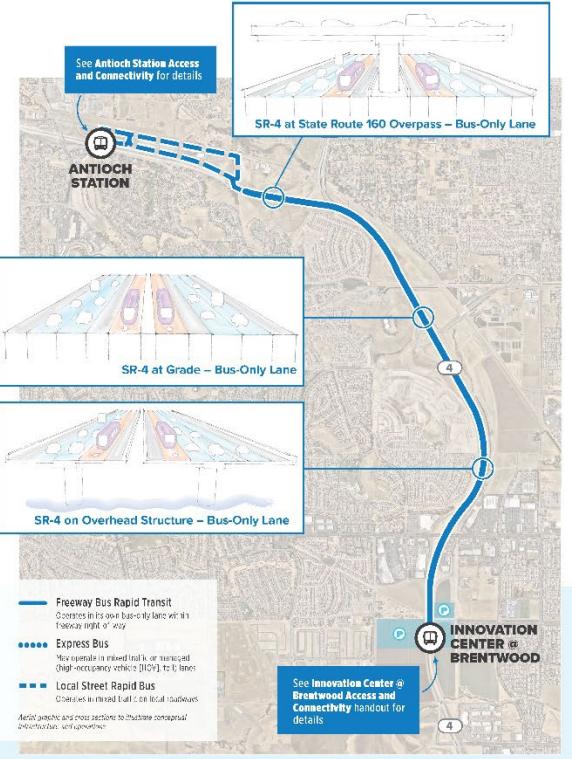


Potential Impacts



To learn more about this and all other alternatives, visit eastcountyttransit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.



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ALTERNATIVE 3

Bus Rapid Transit from the Future Innovation Center @ Brentwood to Pittsburg / Bay Point

Build new bus-only lanes in the State Route 4 (SR-4) median from Brentwood through the State Route 160 (SR-160) interchange to support service that runs to the existing BART Pittsburg / Bay Point Station.

Overview



- Bus rapid transit using no-emission, hydrogen electric* buses in bus-only lanes within freeway right-of-way in median between the future Innovation Center @ Brentwood and the Pittsburg / Bay Point Station.
- Requires bringing buses into and out of the median by modifying lane and/or shoulder configurations east of Hillcrest Avenue to circulate to existing bus platform at Pittsburg / Bay Point Station.
- Avoids traffic near SR-160, because the buses will be in median bus-only lanes. The emergency lane (shoulder) and right-of-way would be preserved.
- May require widening of freeway bridges to maintain number of existing lanes.

Details

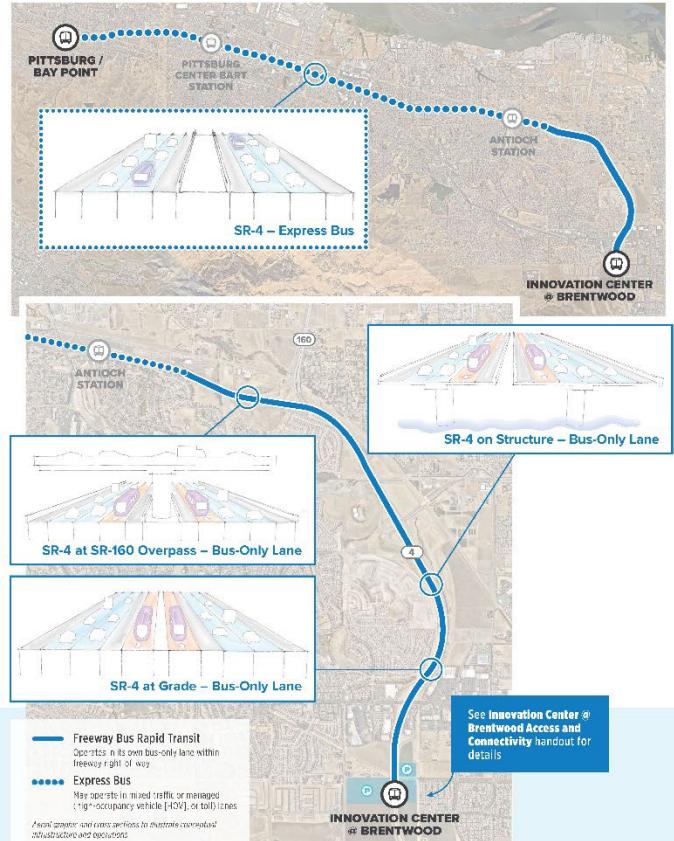
- Supports one-seat ride (no transfers required) from the future Innovation Center @ Brentwood Station to the Pittsburg / Bay Point Station, but does not serve Antioch or Pittsburg Center BART stations.
- Station platform in the median of SR-4 at the future Innovation Center @ Brentwood, provides equal access to communities east and west of SR-4 via future Mokelumne Trail Bicycle/Pedestrian Overcrossing.
- Barrier separation between bus and auto lanes where feasible between Sand Creek Road and SR-160 and preserves space for future BART rail extension, if needed.
- Possible duplication of service with recent BART extension from the Pittsburg/Bay Point Station to the Antioch Station, but would require a larger bus fleet than Alternative 2 to match the frequency of BART service.

Potential Benefits



To learn more about this and all other alternatives, visit eastcountyttransit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.



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ALTERNATIVE 4

Express Bus from the Future Innovation Center @ Brentwood to Antioch

Provide express bus service in existing State Route 4 (SR-4) travel lanes between the future Innovation Center @ Brentwood and the existing BART Antioch Station.

Overview



- No-emission, hydrogen electric* buses using existing SR-4 freeway or managed lanes (high-occupancy vehicle [HOV] or toll).
- Buses exit existing freeway travel lanes at Lone Tree Way and circulate to the bus platforms at the future Innovation Center @ Brentwood.
- Buses exit existing freeway travel lanes at Hillcrest Avenue and circulate to existing bus platform at the Antioch Station.
- Travel times depend on the amount of traffic congestion on SR-4.

Details

- Low-cost option that does not require building transit-only lanes, or a station in the SR-4 median. Less infrastructure investments also allow for a faster implementation timeline.
- Future transit bus bays at the Innovation Center @ Brentwood would be located on only one side (either the east, or the west) of the SR-4 right-of-way.
- Potential circulation and/or accessibility tradeoffs for communities on either side of the freeway would access the Innovation Center @ Brentwood bus platforms via the Mokelumne Trail Bicycle/Pedestrian Overcrossing.
- Trips to central Contra Costa County and/or the Bay Area require transfers to BART at the Antioch and Pittsburg / Bay Point stations.

Potential Benefits



Low Cost Solution



Less Time to Implement



More Transfers



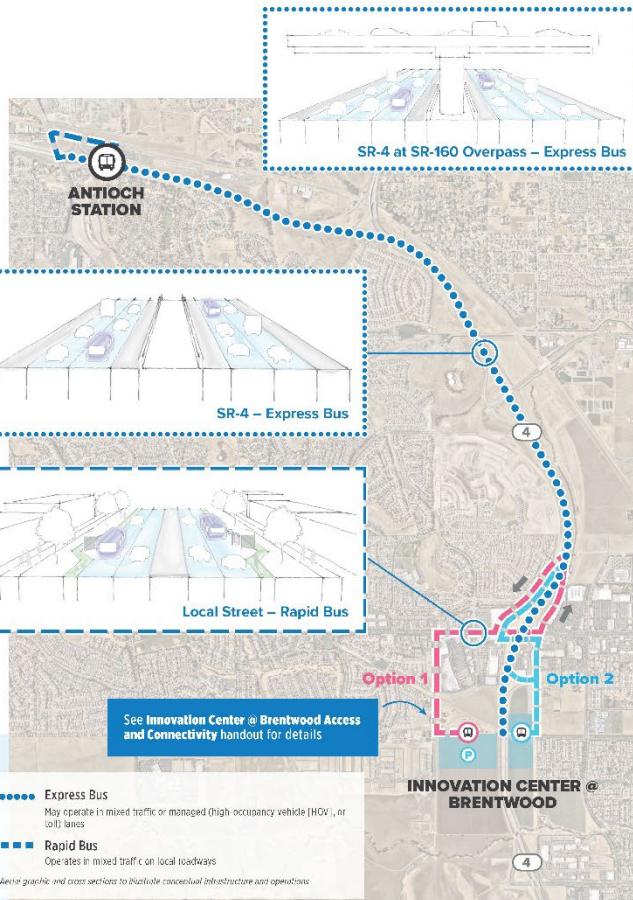
No Transit Only Spaces



Longer Travel Time

To learn more about this and all other alternatives, visit eastcountyttransit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.



ALTERNATIVE 5

Express Bus from the Future Innovation Center @ Brentwood to Pittsburg / Bay Point

Provide express bus service in existing State Route 4 (SR-4) travel lanes between the future Innovation Center @ Brentwood and the existing BART Pittsburg / Bay Point Station.

Overview



- No-emission, hydrogen electric* buses using existing SR-4 freeway or managed lanes (high-occupancy vehicle [HOV] or toll).
- Buses exit existing freeway travel lanes at Lone Tree Way and circulate to the bus platforms at the future Innovation Center @ Brentwood (site location tbd).
- Buses exit SR-4 at Railroad Avenue and circulate to existing bus platforms at the Pittsburg / Bay Point Station.
- Travel times depend on the amount of traffic congestion on SR-4.

Details

- Supports one-seat ride (no transfer required) from the Innovation Center @ Brentwood Station to the Pittsburg / Bay Point Station and BART network (excluding the Antioch and Pittsburg Center stations).
- Low-cost option that does not require building a station in the SR-4 median. Less infrastructure investments also allow for a faster implementation timeline.
- Future transit bus bays at the Innovation Center @ Brentwood Station would be located on only one side (either the east, or the west) of the SR-4 right-of-way.
- Potential circulation and/or accessibility tradeoffs for communities on either side of the freeway would access the Innovation Center @ Brentwood Station bus platforms via the Mokelumne Trail Bicycle/Pedestrian Overcrossing.
- Possible duplication of service with recent BART extension from the Pittsburg/Bay Point Station to the Antioch Station, but would require larger bus fleet to match frequency of BART service over a longer distance.

Potential Benefits



Low Cost Solution



Less Time to Implement



Less Transfers



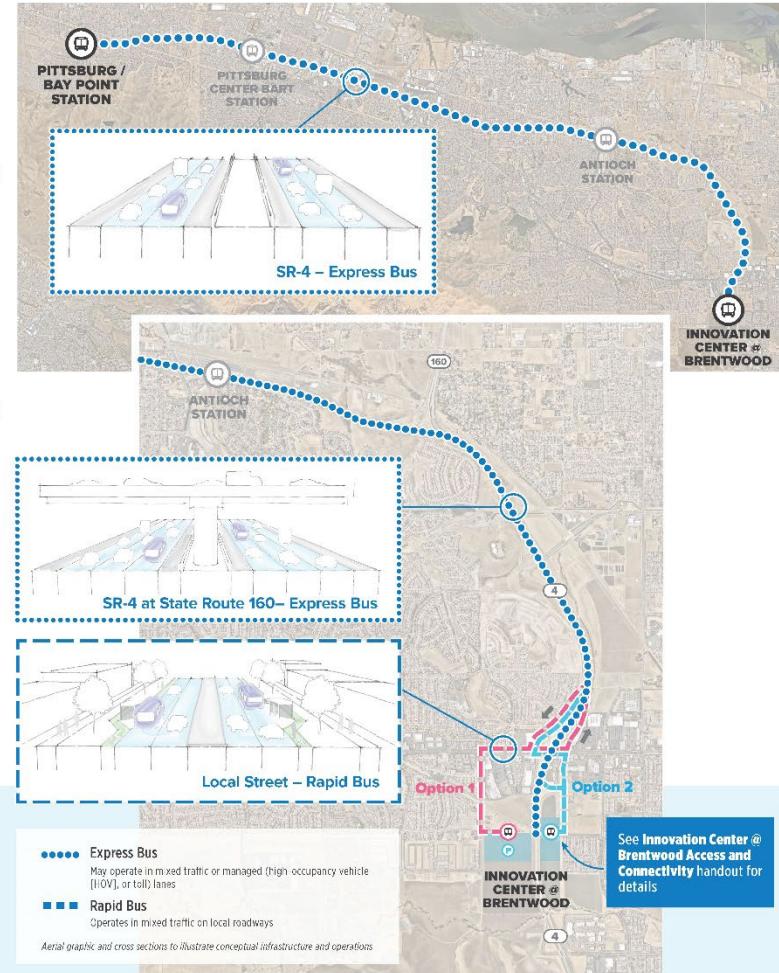
No Transit Only Spaces



Quality of Access

To learn more about this and all other alternatives, visit eastcountytransit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.



ALTERNATIVE 6

Rapid Bus on Local Streets from the Future Innovation Center @ Brentwood to Antioch

Provide rapid bus service using existing and new local street network between the future Innovation Center @ Brentwood Station and the existing Antioch Station.

Overview



- No-emission, hydrogen electric* buses operate with limited stops between the future Innovation Center @ Brentwood and existing bus platforms at the Antioch Station.
- Buses would use the local street network to serve the transit bus bays and park and ride lot at the future Innovation Center @ Brentwood (on only one side – the east or the west side – of the SR-4 freeway).
- Two route options have been identified:
 - A** Via existing Hillcrest Avenue, which is the most direct route to Antioch, but is subject to peak traffic congestion.
 - B** Via Slatten Ranch Road, which does not yet exist, but could be built to include transit-only lanes or treatments that remove buses from potential traffic congestion.

Potential Benefits



Less Time to Implement



Longer Travel Time



No Transit Only Spaces

To learn more about this and all other alternatives, visit eastcountytransit.com.

*This study is funded by a grant from Caltrans, which requires all alternatives to use zero-emission/electric transit vehicles.

Details

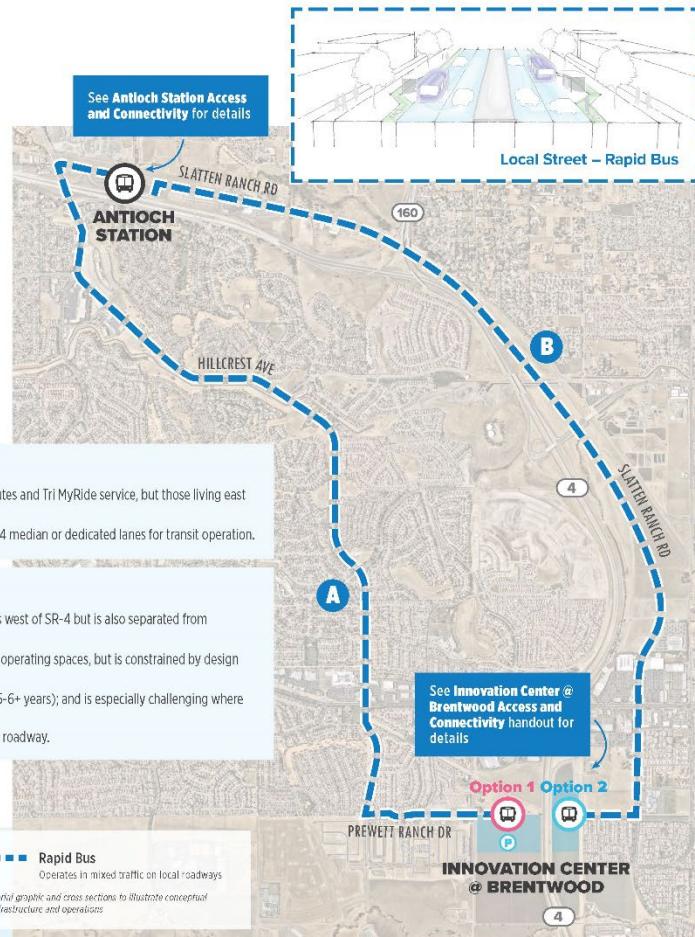
- Travel on local streets and closer to neighborhoods may improve first/last mile connectivity.
- Travel on local streets increases travel time because of lower speeds, intersection delays, and additional stops, which also decreases reliability.
- Trips to central Contra Costa County and/or the Bay Area require transfers to the Antioch and Pittsburg / Bay Point BART stations.

A Hillcrest Avenue Route

- People living west of SR-4 are already served by Tri Delta fixed routes and Tri MyRide service, but those living east of SR-4 may be less likely to use this route.
- Low-cost option that does not require building a station in the SR-4 median or dedicated lanes for transit operation.

B Slatten Ranch Road Route

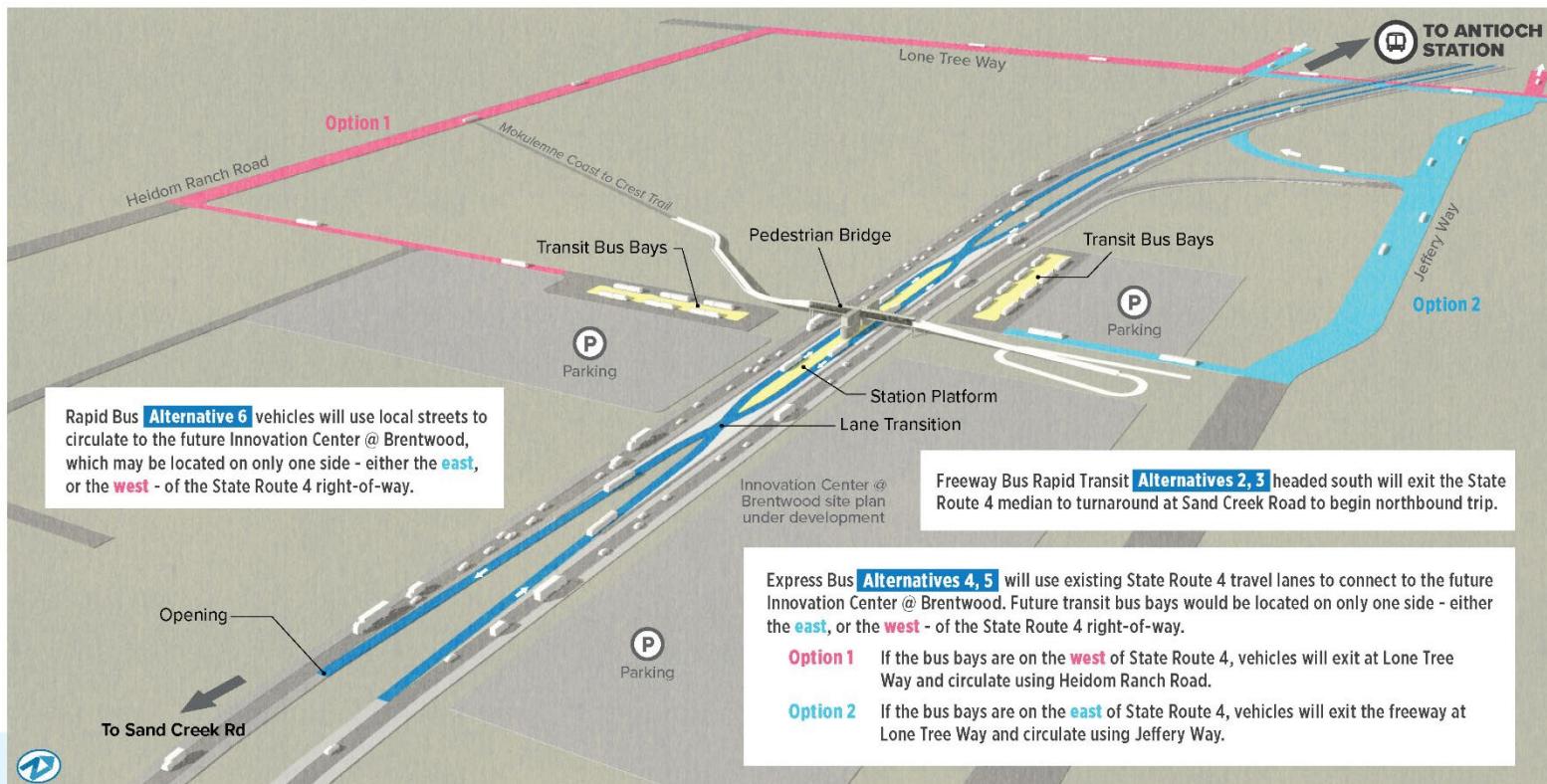
- May benefit communities east of SR-4 more than the communities west of SR-4 but is also separated from Brentwood and Oakley neighborhoods by the Moccasin rail line.
- Constructing a new roadway provides opportunity for transit-only operating spaces, but is constrained by design challenges, operational needs, and limited funding.
- Building a new roadway will take longer to design and construct (5-6+ years); and is especially challenging where the route intersects SR-160.
- Bus rapid transit is not a catalyst for funding construction of a new roadway.



ALTERNATIVE 2, 3, 4, 5 and 6 Future Innovation Center @ Brentwood Access and Connectivity

ALTERNATIVES NOT SHOWN

Alternative 1 – The BART rail station will be located in the median of State Route 4 at approximately the same location as the platform for the Bus Rapid Transit alternatives. An additional elevated track south of the station platform would be constructed to support vehicle turnaround and temporary storage.



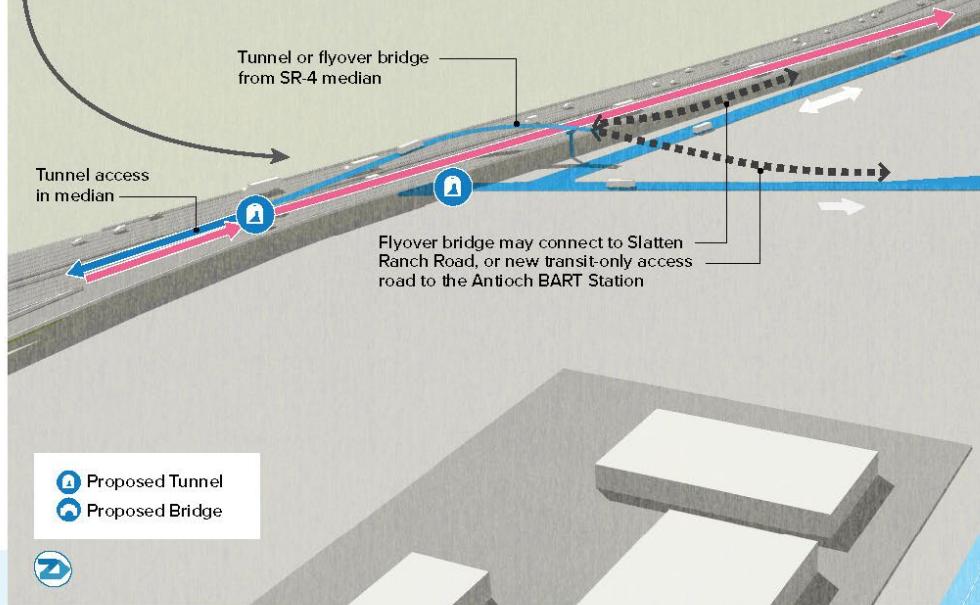
To learn more about this and all other alternatives, visit eastcountytransit.com.

ALTERNATIVE 2, 3 and 6 Antioch Station Access and Connectivity

Freeway Bus Rapid Transit (Alternatives 2, 3) will enter/exit the State Route 4 (SR-4) median east of the Antioch Station and access the existing bus platforms at the Antioch BART Station via:

Alternative 2: A tunnel or flyover bridge between the SR-4 median and a new access road on the north side of the freeway.

Alternative 3: An opening in the median barrier to use existing freeway lanes to travel directly to the Pittsburg / Bay Point Station via general purpose lanes.



To learn more about this and all other alternatives, visit eastcountytransit.com.

ALTERNATIVES NOT SHOWN

Alternative 1 would extend the existing rail infrastructure in the SR-4 median south to the future Innovation Center @ Brentwood.

Alternative 4 express buses would operate in existing SR-4 travel lanes to exit at Hillcrest Ave (like today) and circulate to the existing Antioch Station.

Alternative 5 express buses would operate in existing SR-4 travel lanes traveling directly to the Pittsburg/Bay Point Station, and would not serve Antioch Station

