Zero-Emission Bus Rollout Plan

Prepared by Banning Connect Transit Service with support from the Center for Transportation and the Environment, Arcadis IBI Group, and the Riverside County Transportation Commission

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ADA: Americans with Disabilities Act

A&E: Architecture and Engineering

BEB: Battery Electric Bus

CA: California

CARB: California Air Resources Board

CNG: Compressed Natural Gas

COVID/COVID-19: Coronavirus Disease 2019 (SARS-CoV-2)

CTE: Center for Transportation and the Environment

DAC: Disadvantaged Community

FCEB: Fuel Cell Electric Bus

HVAC: Heating, Ventilation, and Air Conditioning

ICE: Internal Combustion Engine

ICT: Innovative Clean Transit

kW: Kilowatt

kWh: Kilowatt-Hour

MW: Megawatt

OEM: Original Equipment Manufacturer

PM: Particulate Matter

PPI: Producer Price Index

CPI: Consumer Price Index

RFP: Request for Proposals

SCE: Southern California Edison (SoCal Edison)

TDA: Transportation Development Act

VTT: Verification of Transit Training

ZEB: Zero-Emission Bus

A glossary of useful terms can also be found in Appendix B - Glossary

Executive Summary

Banning Connect Transit Service (Banning Connect) provides public transit services in and around the City of Banning, a suburban community located east of Riverside and southeast of San Bernardino in Riverside County. Banning Connect operates three fixed routes during the weekdays, two (2) fixed routes on the weekends, and Dial-A-Ride (DAR) service. Banning Connect's fleet, as of 2022, consists of four (4) Compressed Natural Gas (CNG) transit buses, three (3) CNG cutaways, and two (2) gasoline cutaways. Riverside County Transportation Commission (RCTC) awarded a contract to the Center for Transportation and the Environment (CTE) to perform a zero-emission bus (ZEB) transition study to create a plan for a 100% zero-emission fleet by 2040 on behalf of transit agencies and municipal transportation services in the cities of Banning, Beaumont, Corona and Riverside and the Palo Verde Valley Transit Agency to comply with the Innovative Clean Transit (ICT) regulation enacted by the California Air Resources Board (CARB). This report will focus on Banning Connect's transition plan to zero-emission technology.

Banning Connect's Rollout Plan achieves a zero-emission bus fleet in line with the 2040 target of the ICT Regulation. To achieve this goal, Banning Connect will replace all CNG and gasoline buses with ZEBs when the vehicles reach the end of their 12-year useful life. By 2040, all 9 of the agency's buses are expected to be battery electric buses (BEBs). The last of the agency's gasoline buses will reach end of life in 2025 and the last of the CNG buses will reach end of life in 2039.

Banning Connect's entire fixed-route and DAR transit fleet operates out of 176 East Lincoln Street, known by the city as the Corporation Yard. The facility houses Banning's slow-fill CNG fueling station, its five maintenance bays, an outside vehicle wash bay, and its administrative facilities. In their SRTP, Banning Connect has listed plans to replace its current slow-fill CNG station, which is well beyond its useful life, in addition to including a public dispenser to the fueling station. Banning Connect plans to install charging infrastructure at this location to support their BEB fleet. Banning Connect's customer service operations are centered at the City of Banning Community Services Center at 789 North San Gorgonio Avenue, where riders can purchase bus passes, get bus schedules, and complete ADA applications.

Banning Connect's bus service provides transportation opportunities to Disadvantaged Communities (DACs) and moving toward zero-emission buses will help improve the health of DACs and non-DACs alike. The agency will build upon an existing training structure for bus maintenance and operators to provide the necessary battery-electric bus (BEB) specific training that will be required for the agency to own and operate BEBs. The agency estimates that pursuing a ZEB fleet in place of a CNG and gasoline fleet will cost an additional $5M in bus costs and infrastructure alone between 2022 and 2040, which will require significantly more funding opportunities. Banning Connect plans to pursue funding opportunities at the federal, state, and local levels to help fill this funding gap.

A

Transit Agency Information

Banning Connect Profile

History

The City of Banning ("Banning") is strategically located astride Interstate 10 between the Inland Empire and the Coachella Valley in the San Gorgonio Pass. The City, incorporated in 1913, has a rich and colorful history.

Initially Banning served as a stagecoach and railroad stop between the Arizona territories and Los Angeles. This history has contributed to the present-day spirit of pioneer resourcefulness and "can do" attitude that is so prevalent in the community.

Banning has provided public transportation service since April 1973, which expanded to two routes in September 1985. The current transit system comprises three fixed-route services and a Dial-a-Ride system that is limited to seniors (60 + years of age) and persons with disabilities, including riders certified under the Americans with Disabilities Act (ADA). The newest of the three fixed routes, the Cabazon service, which began in July 1995, extends from Banning east to the unincorporated area of Cabazon. This route was extended in January 2000 to provide a route deviation to serve a remote residential area in eastern Cabazon.

The Banning transit system serves several areas, including the commercial and residential areas of Banning and Cabazon, as well as the commercial areas of the Morongo Indian Reservation and limited commercial areas in the City of Beaumont ("Beaumont"). Banning transit services cover approximately 35 square miles in the pass area with routes connecting to regional services.

Within the service area, population is mixed with areas of both high and low densities. The current routes have been planned by taking advantage of this knowledge, allowing the system to operate more efficiently.

There is significant growth happening in Banning with the development of two large specific plan development projects and several industrial developments. It is anticipated that the growth will provide additional opportunities that will benefit the Banning Connect Transit Service.

Service Area and Bus Service

Banning Connect Transit Service (Banning Connect) provides public transit services in and around the City of Banning, a suburban community located east of Riverside and southeast of San Bernardino in Riverside County. Banning Connect provides service along three fixed routes during the weekdays and two fixed routes on the weekends[1]. As of July 2022, the transit agency's bus fleet consists of four (4) 32-ft. and 33.5-ft. CNG transit buses, including two (2) ElDorado National E-Z Rider II CNG buses and two (2) ElDorado National XHF CNG buses, and two (2) 32-ft ElDorado Bus CNG cutaways . Banning Connect's fixed route service connects the cities of Banning, Cabazon, Beaumont, and the Morongo Indian Reservation, covering an area of approximately 35 square miles. The Cities of Banning and Beaumont have executed an Interagency Service Agreement, which allows each city's transit service to operate within both cities, allowing Banning residents to access Beaumont's commercial area. Banning

[1] Short Range Transit Plan, City of Banning

also has a Memorandum of Understanding with the Morongo Band of Mission Indians which allows bus stops within their property, including the Casino Morongo and the town of Cabazon. Within the City of Banning, bus routes provide service to the San Gorgonio Hospital, Mid-County Courthouse, Banning Library, Banning High School, Mount San Jacinto College and Hemmerling Elementary School.

In addition to fixed-route service, Banning Connect provides dial-a-ride (DAR) service. This service is provided for Seniors 60 and older; persons with disabilities; and persons certified under the Americans with Disability Act (ADA). The DAR service is primarily used for medical appointments, workshop programs, and shopping areas. Unlike fixed-route service, the DAR service does not run a set route, and so a single vehicle may provide trips both within and outside of a DAC during a single day. As of July 2022, Banning's paratransit fleet consists of one (1) Glaval CNG cutaway, one (1) El Dorado gas cutaway, and one (1) Starcraft Bus gas cutaway. Banning Connect's service map is illustrated in **Figure 1.**

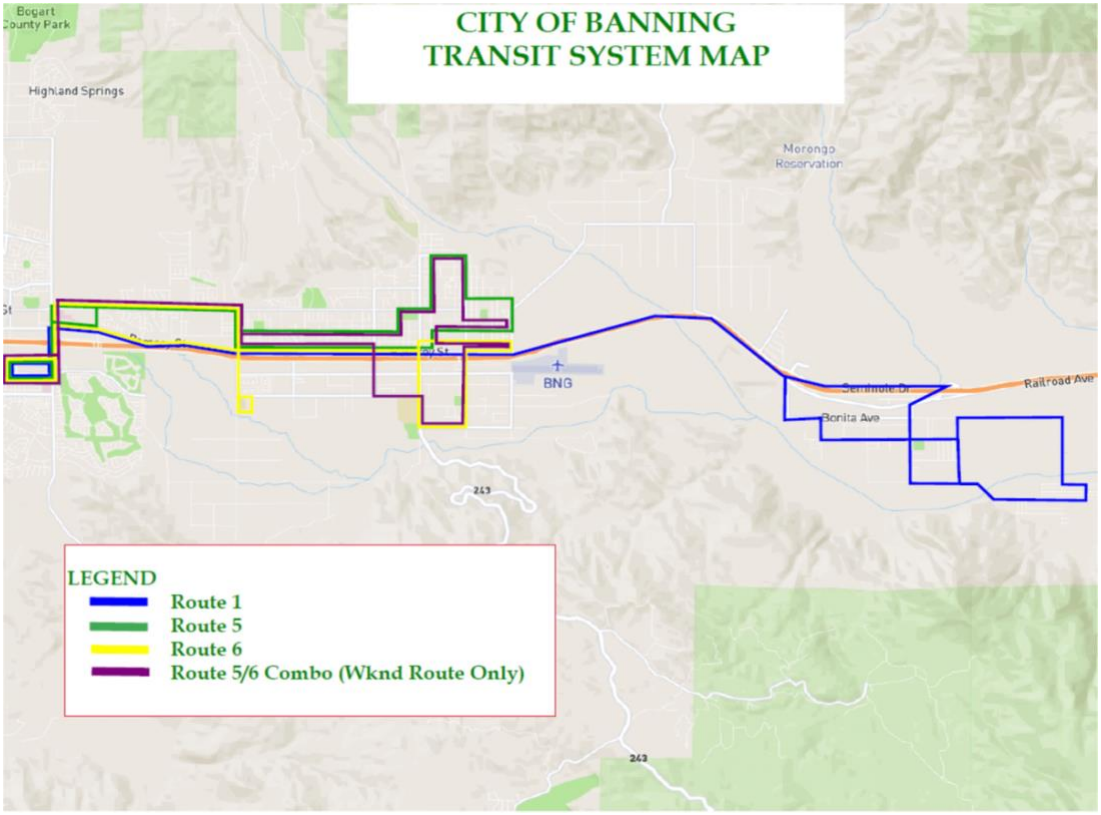

Figure 1 – Banning Connect Service Area

Ridership

Banning Connect had a total of 87,624 passengers in the 2020/2021 fiscal year for both fixed route and DAR services and 49,612 in the third quarter of the 2021/2022 fiscal year. Based on this ridership data, Banning Connect staff estimated a total of 65,898 passengers in the 2022/2023 fiscal year, with 63,245 on fixed route services and 2,653 on DAR services.

The Banning transit system has seen a slight downward trend in ridership since 2016. An increase in ridership was realized in the first quarter of the 2019/2020 fiscal year resulting from the new Interagency Services Agreement with the City of Beaumont, but later drastically dropped due to COVID-19. In the 2021/2022 fiscal year, final numbers are projected to be lower, by about 50% as compared to pre-pandemic numbers. While the reduction in ridership carried into the beginning of FY 2022/2023, ridership trends are now beginning to increase, indicating a potential return to near pre-pandemic ridership levels.

Banning Connect staff will continue to monitor key performance metrics throughout the year in order to identify underperforming routes and trips and make adjustments as necessary. Additionally, staff plans to develop a Comprehensive Operational Analysis (COA) once ridership numbers normalize to pre-Covid-19 numbers, hopefully in FY 2023/2024. One goal of the COA will be to develop a plan for improving Banning Connect's routes to make them more efficient so the agency can continue to meet the needs of Banning's riders. Banning Connect also plans to increase ridership by participating in community events and raising awareness on the benefits of public transit. This will include agency staff attending senior community meetings, highlighting new routes in articles of local papers, partnering with nearby transit agencies to provide training to passengers in the area, and more.

Banning Connect Basic Information

Transit Agency's Name:

Banning Connect Transit Service

Mailing Address:

Banning Connect Transit Service

176 East Lincoln Street

Banning, CA 92220

Transit Agency's Air Districts:

Banning Connect is part of the South Coast Air Quality Management District (SCAQMD).

Transit Agency's Air Basin:

South Coast Air Quality Management District is part of the South Coast Air Basin.[2]

Total number of buses in Annual Maximum Service:

The maximum number of active buses operating fixed route and DAR services out of the Corporation Yard is nine (9).

Urbanized Area:

Banning, CA. Banning is 23 square miles of land area with 1,282 people per square mile living within that area.

Population of Urbanized Area:

Over 29,000 residents[3]

[2] https://www.rcrcd.org/south-coast-air-quality-management-district-scaqmd

[3] Short Range Transit Plan, City of Banning

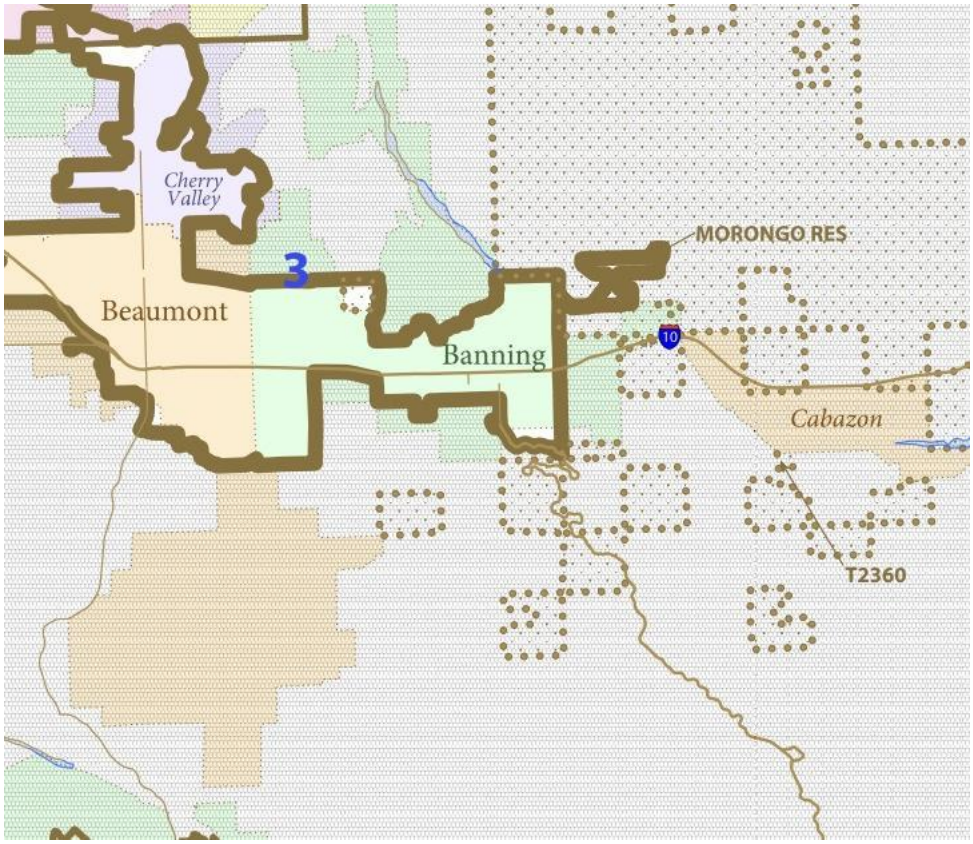

Figure 2 – City of Banning Urbanized and Rural Map[4][5]

Contact Information for Inquiries on the Banning Connect ICT Rollout Plan:

Stephanie Sirls, Transit Manager, Banning Connect Transit Service

176 East Lincoln Street

Banning, CA 92220

Tel: (951) 922-3243

ssirls@banningca.gov

Is your transit agency part of a Joint Group? No

[4] https://www2.census.gov/geo/maps/dc10map/UAUC_RefMap/ua/ua75340_riverside--san_bernardino_ca/DC10UA75340_000.pdf

[5] Solid brown lines represent the boundaries of the urbanized area

Fleet Facility

Banning Connect's entire fixed-route and DAR transit fleet operates out of 176 East Lincoln Street, known by the city as the Corporation Yard. The facility houses Banning's slow-fill CNG fueling station, its five maintenance bays, an outside vehicle wash bay, and its administrative facilities. In their Short-Range Transit Plan (SRTP), Banning Connect has listed plans to replace its current slow-fill CNG station, which is well beyond its useful life, in addition to including a public dispenser to the fueling station. Banning Connect's customer service operations are centered at the City of Banning Community Services Center at 789 North San Gorgonio Avenue, where riders can purchase bus passes, get bus schedules, and complete ADA applications. A map of the Corporation Yard is shown in **Figure 3** and a map of the Community Services Center is shown in **Figure 4** to understand the locations of Banning Connect's properties in relation to one another, as well as to routes and service areas. These facilities offer a starting point for the consideration of viable locations for BEB charging infrastructure.

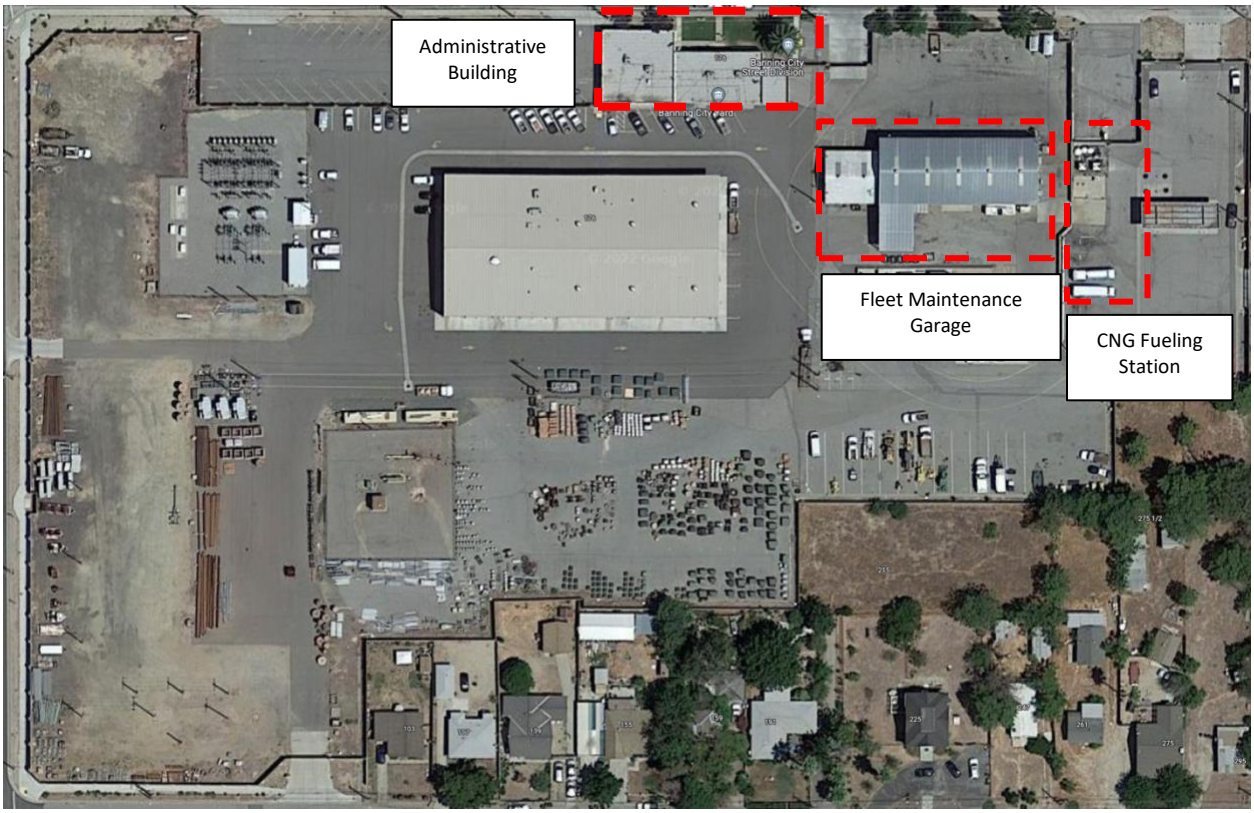

Figure 3 – Banning Connect Fueling, Administrative, and Storage Facility Overview

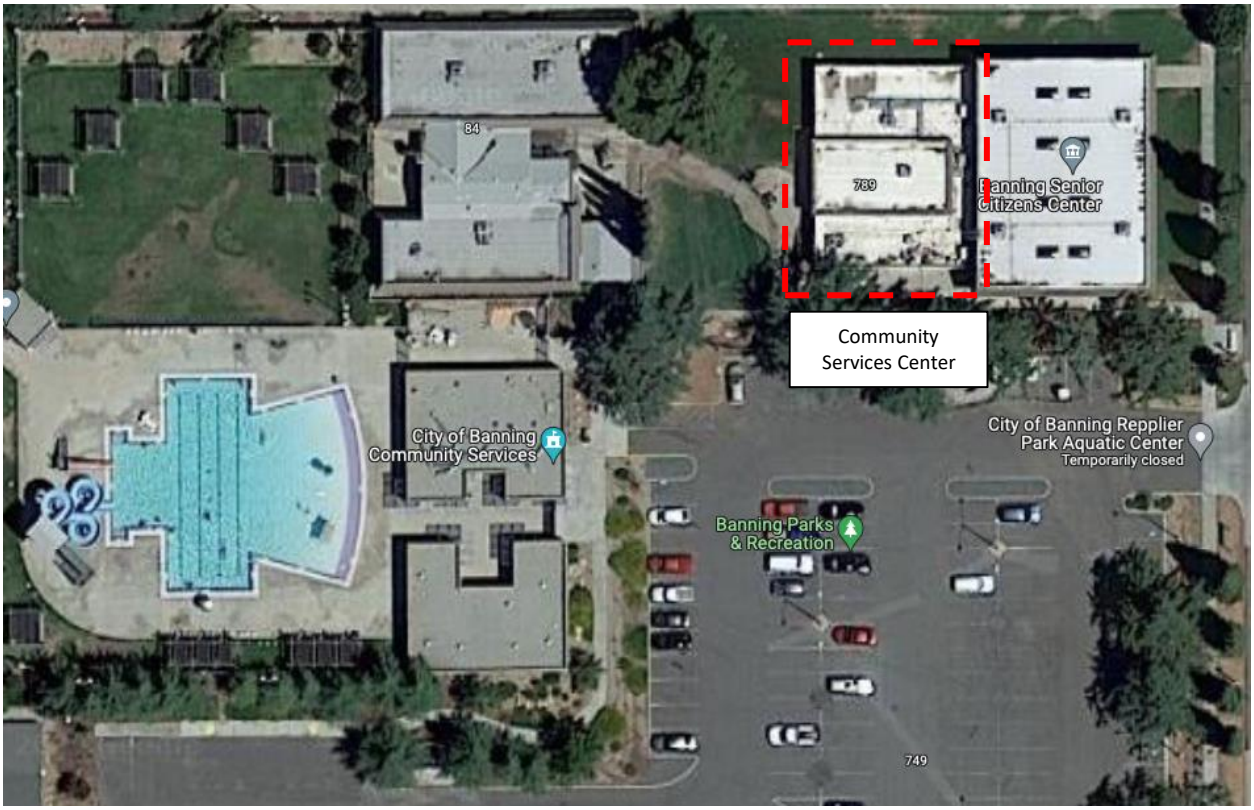

Figure 4 – Banning Connect Community Services Facility Overview

Banning Connect's Sustainability Goals

Per their Clean & Green Report from June 2008[6], the City of Banning has dedicated themselves to sustainability; "maximizing energy efficiency; optimizing resource use while minimizing negative environmental impacts; minimizing waste production and pollution; capturing the benefits of natural processes while minimizing damage from natural events; and meeting the economic and social needs of all its people in a manner that does not degrade or destroy the productivity of its natural and man-made systems." The report details the City's commitment to improving the region's air quality, transit, and transportation issues through its Clean Fuel Fleet Program, City Rideshare Programs, etc. The Banning Electric Utility Department offers several rebates and incentives to its residential and commercial communities; however, it does not currently have any programs specific to electric vehicles (EVs). The utility's portfolio consists of 53.9% eligible renewable energy, with a greenhouse gas emissions intensity of 313 lbs. CO_2e/MWh.

California's plan to address public health, air quality and climate protection goals includes the Innovative Clean Transit (ICT) regulation, which aims to reduce greenhouse gas (GHG), nitrogen oxide (NOx), and diesel particulate emissions, with which Banning Connect will be compliant at the conclusion of this project. To accomplish its sustainability goals, Banning Connect is working to replace its CNG and gas fleet with 100% zero-emission vehicles by 2040 in accordance with ICT regulations.

Banning Connect has developed a plan to transition to a fully zero emission bus (ZEB) fleet composed of battery electric buses by 2040, in accordance with the Innovative Clean Transit (ICT) regulation, requiring all California transit agencies to follow zero-emission procurement guidelines with the goal of achieving 100% zero-emission fleets by 2040. Banning Connect has committed to purchasing zero emission buses, demonstrating the agency's commitment to reducing emissions. Banning Connect has worked with CTE to select a plan that prioritizes local

[6] https://www.ci.banning.ca.us/DocumentCenter/View/557/Banning_Clean--Green-Report?bidId=

needs and conditions, namely considering resilience, redundancy, and emergency response adaptation options. Banning Connect's transition to a fully ZEB fleet will ultimately benefit communities through cleaner air, greater independence from fossil fuels, and more environmental sustainability.

B

Rollout Plan General Information

Overview of the Innovative Clean Transit Regulation

On December 14, 2018, CARB enacted the Innovative Clean Transit (ICT) regulation, setting a goal for California public transit agencies to have zero-emission bus fleets by 2040. The regulation specifies the percentage of new bus procurements that must be zero-emission buses for each year of the transition period (2023–2040). The annual percentages for Small Transit agencies are as follows:

ICT Zero-Emission Bus Purchase Requirements for Small Agencies:

January 1, 2026 - 25% of all new bus purchases must be zero-emission

January 1, 2027 - 25% of all new bus purchases must be zero-emission

January 1, 2028 - 25% of all new bus purchases must be zero-emission

January 1, 2029+ - 100% of all new bus purchases must be zero-emission

March 2021-March 2050 – Annual compliance report due to CARB

This purchasing schedule guides agency procurements to realize the goal of zero-emission fleets in 2040 while avoiding any early retirement of vehicles that have not reached the end of their 12-year useful life. Agencies have the opportunity to request waivers that allow purchase deferrals in the event of economic hardship or if zero-emission technology cannot meet the service requirements of a given route. These concessions recognize that zero-emission technologies may cost more than current internal combustion engine (ICE) technologies on a vehicle lifecycle basis and that zero-emission technology may not currently be able to meet all service requirements.

Banning Connect's Rollout Plan General Information

Rollout Plan's Approval Date: May 23, 2023

Resolution No: 2023-91

Is a copy of the approved resolution attached to the Rollout Plan? Yes

Contact for Rollout Plan follow-up questions:
Stephanie Sirls, Transit Manager, Banning Connect Transit Service

176 East Lincoln Street

Banning, CA 92220

Tel: (951) 922-3243

ssirls@banningca.gov

Who created the Rollout Plan?
This Rollout Plan was created by the City of Banning, with assistance from the Center for Transportation and the Environment (CTE) and the Riverside County Transportation Commission (RCTC).

This document, the ICT Rollout Plan, contains the information for Banning Connect's zero-emission fleet transition trajectory as requested by the ICT Regulation. It is intended to outline the high-level plan for implementing the

transition. The Rollout Plan provides estimated timelines based on information on bus purchases, infrastructure upgrades, workforce training, and other developments and expenses that were available at the time of writing.

Additional Agency Resources

Banning Connect agency website: https://banningca.gov/

C

Technology Portfolio

ZEB Transition Technology Selection

Based on outcomes of the zero-emission fleet transition planning study completed by CTE, Banning Connect plans to transition its fleet to battery electric buses. By 2040, Banning Connect expects to operate a fully battery electric fleet of 9 transit vehicles.

A BEB-only fleet scenario will allow Banning Connect to focus on implementing one zero-emission propulsion technology as opposed to a mixed technology zero-emission fleet as well as avoid the higher fuel cost of hydrogen for a mixed-fleet or FCEB-only fleet. This plan also summarizes the charging infrastructure costs needed to support a fleet of 9 BEBs.

Local Developments and Regional Market

California has become a global leader for zero-emission buses, as well as the zero-emission fuel and fueling infrastructure required to support these vehicles. California is home to four bus OEMs that manufacture zero-emission buses, all having experience in building BEB technology in particular.

The state legislature has fostered growth in zero-emission fuels through the state's Low-Carbon Fuel Standard (LCFS) program, which incentivizes the consumption of fuels with a lower carbon intensity than traditional combustion fuels and through funding opportunities offered by CARB and CEC. The state's electrical utility companies have also supported the transition to ZEB technology by offering incentive programs for heavy duty EV charging infrastructure and service upgrades. California BEB deployments represent 37% of the nation's BEB deployments. [7]

Three of the major BEB OEMs manufacture buses in California with two manufacturing sites located in Southern California. Nearby agencies such as Long Beach Transit, LA Metro, and Foothill California have some of the most mature BEB deployments in the country. This year, the FTA also awarded battery-electric bus and charging infrastructure projects under the FY2022 Low-No Emission Vehicle Program. In Los Angeles County, Los Angeles County Metropolitan Transportation Authority (LA Metro) was awarded $104.2 million, and the City of Gardena was awarded $2.22 million to procure battery-electric buses and charging equipment. In Riverside County, Sunline Transit Agency was awarded an additional $7.15 million to procure battery electric buses and charging stations, and in Orange County, Orange County Transportation Authority (OCTA) was awarded $2.51 million to purchase zero-emission buses to improve air quality and paratransit service.

[7] CALSTART. 2021. THE ADVANCED TECHNOLOGY TRANSIT BUS INDEX: A NORTH AMERICAN ZEB INVENTORY REPORT. https://calstart.org/wp-content/uploads/2022/01/2021-ZIO-ZEB-Final-Report_1.3.21.pdf

ZEB Transition Planning Methodology

Banning Connect's ICT Rollout Plan was created in combination with Banning Connect's Existing Conditions Report and the Riverside County ZEB Financial Strategy Plan, utilizing CTE's ZEB Transition Planning Methodology. CTE's methodology consists of a series of assessments that enable transit agencies to understand what resources and decisions are necessary to convert their fleets to zero-emission technologies. The results of the assessments help the agency decide on a step-by-step process to achieve its transition goals. These assessments consist of data collection, analysis, and modeling outcome reporting stages. These stages are sequential and build upon findings in previous steps. The assessment steps specific to Banning Connect's Rollout Plan are outlined below:

1. Planning and Initiation
2. Requirements Analysis & Data Collection
3. Service Assessment
4. Fleet Assessment
5. Fuel Assessment
6. Maintenance Assessment
7. Facilities Assessment
8. Total Cost of Ownership Assessment
9. Policy Assessment
10. Partnership Assessment

For **Requirements Analysis & Data Collection,** CTE collects data on the agency's fleet, routes and blocks, operational data (e.g., mileage and fuel consumption), and maintenance costs. Using this data, CTE establishes service requirements to constrain the analyses in later assessments and produce agency-specific outputs for the zero-emission fleet transition plan.

The **Service Assessment** phase initiates the technical analysis phase of the study. Using information collected in the Data Collection phase, CTE evaluates the feasibility of using zero-emission buses to provide service to the agency's routes and blocks over the transition plan timeframe from 2022 to 2040. Results from the Service Assessment are used to guide ZEB procurement plans in the Fleet Assessment and to determine energy requirements in the Fuel Assessment.

The **Fleet Assessment** projects a timeline for the replacement of existing buses with ZEBs that is consistent with Banning Connect's existing fleet replacement plan and known procurements. This assessment also includes a projection of fleet capital costs over the transition timeline and is optimized to meet state mandates or agency goals, such as minimizing costs or maximizing service levels.

The **Fuel Assessment** merges the results of the Service Assessment and Fleet Assessment to determine annual fuel requirements and associated costs. The Fuel Assessment calculates energy costs through the full transition timeline for each fleet scenario, including the agency's existing CNG and gasoline buses. To more accurately estimate battery electric bus (BEB) charging costs, a focused Charging Analysis is performed to simulate daily system-wide energy use. As older technologies are phased out in later years of the transition, the Fuel Assessment calculates the changing fuel requirements as the fleet transitions to ZEBs. The Fuel Assessment also provides a total fuel cost over the transition timeline.

The **Maintenance Assessment** calculates all projected fleet maintenance costs over the transition timeline. Maintenance costs are calculated for each fleet scenario and include costs of maintaining existing fossil-fuel buses that remain in the fleet and maintenance costs of new BEBs.

The **Facilities Assessment** determines the infrastructure necessary to support the projected zero-emission fleet composition over the transition period based on results from the Fleet Assessment and Fuel Assessment. This assessment evaluates the required quantities of charging infrastructure and/or hydrogen fueling station projects and calculates the costs of infrastructure procurement and installation sequenced over the transition timeline.

The **Total Cost of Ownership Assessment** compiles results from the previous assessment stages to provide a comprehensive view of all fleet transition costs, organized by scenario, over the transition timeline.

The **Policy Assessment** considers the policies and legislation that impact the relevant technologies.

The **Partnership Assessment** describes the partnership of the agency with the utility or alternative fuel provider.

Requirements Analysis & Data Collection

The Requirements Analysis and Data Collection stage begins by compiling operational data from Banning Connect regarding its current fleet and operations and establishing service requirements to constrain the analyses in later assessments. CTE requested data such as fleet composition, fuel consumption and cost, maintenance costs, and annual mileage to use as the basis for analyses. CTE conducted a screening-level analysis of Banning Connect's routes by determining their average speed and grades, and classified them as fast or slow and flat or hilly. CTE used these to model the energy efficiencies for each of Banning Connect's routes. The calculated efficiencies were then used in the Service Assessment to determine the energy requirements of Banning Connect's service.

CTE evaluated BEBs and FCEBs to support Banning Connect's technology selection. The range of FCEBs, however, does not have the same level of sensitivity to environmental and operating conditions as BEBs. After collecting route and operational data, CTE determined that Banning Connect's longest block is 307 miles long. Based on observed performance, CTE estimates FCEBs are able to complete any block under 350 total miles, which means that FCEB technology already has the capability to meet Banning Connect's service requirements. Although FCEBs were determined to have the capability of serving all of the agency's routes, Banning Connect was interested in exploring BEB-only service scenarios, so it was necessary to determine how much of Banning Connect's service could feasibly be served by depot-only charged BEBs in order to develop a set of ZEB transition scenarios that would allow the agency to make an informed decision on what technology or technologies would be most suitable to the agency's needs.

The energy efficiency and range of BEBs are primarily driven by bus specifications, such as on-board energy storage capacity and vehicle weight. Both metrics are affected by environmental and operating variables including the route profile (e.g., distance, dwell time, acceleration, sustained top speed over distance, average speed, and traffic conditions), topography (e.g., grades), climate (e.g., temperature), driver behavior, and operational conditions such as passenger loads and auxiliary loads. As such, BEB efficiency and range can vary dramatically from one agency to another or even from one service day to another. It was therefore critical for Banning Connect to determine efficiency and range estimates based on an accurate representation of its operating conditions.

To understand BEB performance on Banning Connect's routes, CTE modeled the impact of variations in passenger load, accessory load, and battery degradation on bus performance, fuel efficiency, and range. CTE ran models with different energy demands that represented *nominal* and *strenuous* conditions. Nominal loading conditions assume average passenger loads and moderate temperature over the course of the day, which places low demands on the motor and heating, ventilation, and air conditioning (HVAC) system. Strenuous loading conditions assume high or maximum passenger loading and near maximum output of the HVAC system. This nominal/strenuous approach offers a range of operating efficiencies to use for estimating average annual energy use (nominal) or planning minimum service demands (strenuous). Route modeling ultimately provides an average energy use per mile (kilowatt-hour/mile [kWh/mi]) for each route, bus size, and load case.

In addition to loading conditions, CTE modeled the impact of battery degradation on a BEB's ability to complete a block. The range of a battery electric bus is reduced over time due to battery degradation. A BEB may be able to service a given block with beginning-of-life batteries, while later it may be unable to complete the entire block at some point in the future as batteries near their end-of-life or derated capacity (typically considered 70-80% of available service energy).

Service Assessment

The Service Assessment focused on evaluating the feasibility of BEBs in Banning Connect's service area. The efficiencies calculated in the Requirements Analysis & Data Collection stage were used to estimate the energy

requirements of Banning Connect's service. The main focus of the Service Assessment is called the block analysis, which determines if generic battery electric technology can meet the service requirements of a block based on range limitations, weather conditions, levels of battery degradation and route specific requirements. The Transit Research Board's Transit Cooperative Research Program defines a block as "the work assignment for only a single vehicle for a single service workday".[8] A block is usually comprised of several trips on various routes. The energy needed to complete a block is compared to the available energy of the bus assigned to service the block. If the bus's usable onboard energy exceeds the energy required by the block, then the conclusion is that the BEB can successfully operate on that block.

The Service Assessment projects the performance of a BEB that is charged overnight at the depot and operates on Banning Connect's service schedule at the time of the plan's writing. The results are used to determine when along the transition timeline a fleet of overnight depot-charged BEBs can feasibly serve Banning Connect's territory or if another zero-emission technology is required to maintain service. This information can then be used to inform the scale and timing of BEB procurements in the Fleet Assessment.

Modeling & Procurement Assumptions

CTE and Banning Connect defined the following assumptions and requirements used throughout the study as follows. The Service Assessment energy profile assumed a 5% improvement in battery capacity every year with a starting battery capacity of 440 kWh for a 35' bus and 580 kWh for a 40' bus, which were the average battery capacities seen in commercially-available buses in 2022. Electric cutaways are modeled to have a battery capacity of 120 kWh and were assumed to have the same 5% rate of improvement in battery capacity every year.

This analysis also assumes Banning Connect will maintain blocks in a similar distribution of distance, relative speeds, and elevation changes to pre-COVID-19 service because buses will continue to serve similar locations within the service area and general topography remains constant even if specific routes and schedules change.

Fleet size and vehicle length distribution do not change over time. The analysis assumed that buses reaching the end of their useful life would be replaced with vehicles of the same size. Total fleet size remains the same over the transition period. Buses are assumed to operate for a 12-year service life and cutaways for a 5- or 7-year service life.

Usable on-board energy is assumed to be that of a mid-life battery (10% degraded) with a reserve at both the high and low end of the battery's charge potential. As previously discussed, battery age affects range, so a mid-life battery was assumed as the average capacity of the battery's service life. Charging batteries to 100% or dropping the charge below 10% also degrades the batteries over time, which is why the analysis assumes that the top and bottom portions of the battery are unusable.

CTE accounts for battery degradation over the transition period with the assumption that Banning Connect can rotate the ZEBs to battery capacity to block energy requirements. As the zero-emission fleet transition progresses, older buses can be moved to shorter, less demanding blocks and newer buses can be assigned to longer, more demanding blocks to account for battery degradation in BEBs over time. Banning Connect can rotate the fleet to meet demand, assuming there is a steady procurement of BEBs each year to match service requirements. CTE accounts for this variability in battery age by using a mid-life usable battery capacity to determine block feasibility.

Fixed Route Results

The Service Assessment determines the timeline for when Banning Connect's service may become achievable by BEBs on a single depot charge. The block analysis determines when, or if, a full transition to BEBs may be feasible. Banning Connect and CTE can then use these results to inform ZEB procurement decisions in the Fleet Assessment. Results from this analysis are also used to determine the specific energy requirements and fuel consumption of the

[8] TRB's Transit Cooperative Research Program. 2014. TCRP Report 30: Transit Scheduling: Basic and Advanced Manuals (Part B). https://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_30-b.pdf

fleet over time. These values are then used in the Fuel Assessment to estimate the costs to operate the transitioning fleet.

While routes and block schedules are unlikely to remain the same over the course of the transition period, these projections assume the blocks will maintain a similar distribution to current service because Banning Connect will continue to serve similar destinations within the city. This core assumption affects energy use estimates and block achievability in each year.

The results of Banning Connect's Service Assessment for fixed route service can be seen below in **Figure 5.** Based on CTE's analysis, 0% of Banning Connect's blocks could be served by a single charge of a depot-only BEB with a 440-kWh battery and, with the assumed 5% improvement every year, 33% of Banning Connect's blocks could be served by this technology by 2036, which means that Banning Connect's service is not feasible with depot-only charged BEBs within the transition period. However, service can be conducted with the addition of on-route charging.

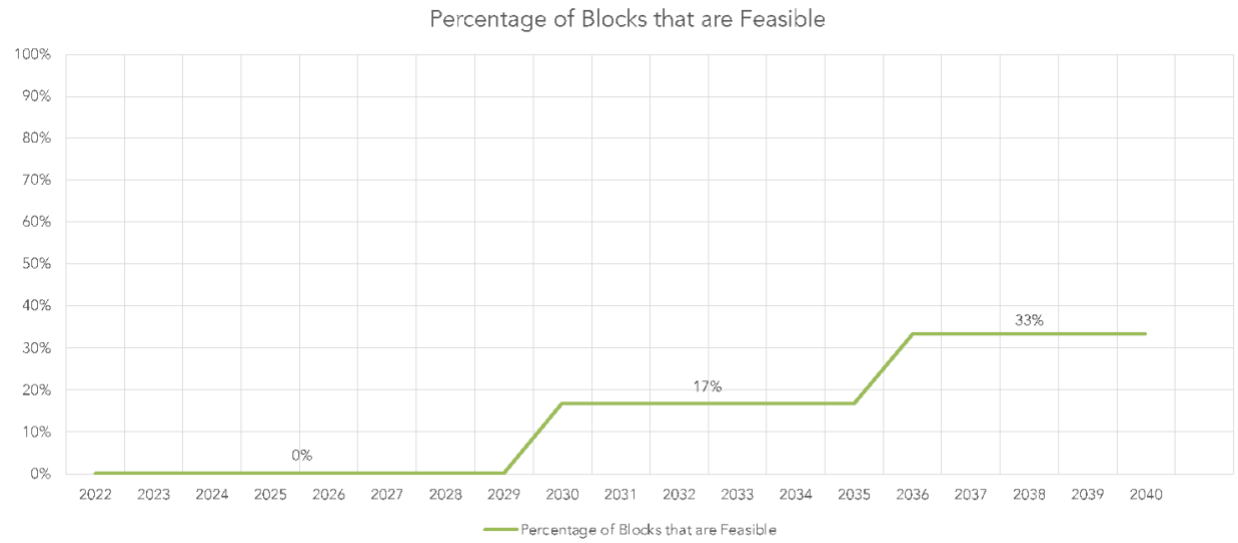

Figure 5 – BEB Block Achievability by Year

DAR Results

CTE's modeling also included an analysis for battery electric cutaway vehicles using Banning Connect's paratransit operational data, the results of which are shown below in **Figure 6.** It is estimated that Banning Connect's paratransit service vehicles operate at an average daily distance of 70 miles per vehicle per day and a maximum of 104 miles per vehicle per day. CTE modeled the electric cutaway performance by calculating the energy demand for each service day and comparing to the usable capacity of a market-representative battery-electric cutaway (99 kWh). It was found that the average service day from 2022 would be feasible, given currently available battery capacity, while Banning Connect's more strenuous days upwards of 75 miles and requiring more than 99 kWh of usable energy would be infeasible. The average service day is similarly feasible in 2030 and 2040. Assuming that the projected battery improvements continue, in 2030, service days of up to 91 miles or 120 kWh will be feasible, while the agency's maximum DAR mileage of 104 miles is expected to only be feasible in 2040.

Based on the results of the analysis, up until 2040, battery-electric cutaways would require some form of opportunity charging throughout the day to complete their service. Pantograph and inductive charging have not yet been demonstrated to be feasible for electric cutaways, so this option was not considered. Demand response service is run sporadically throughout the day, with vehicles typically returning to the depot after completing their assignments. Based on this service pattern, it was assumed that battery-electric cutaways could be charged throughout the day when they return to the depot which would allow them to complete all of Banning Connect's service.

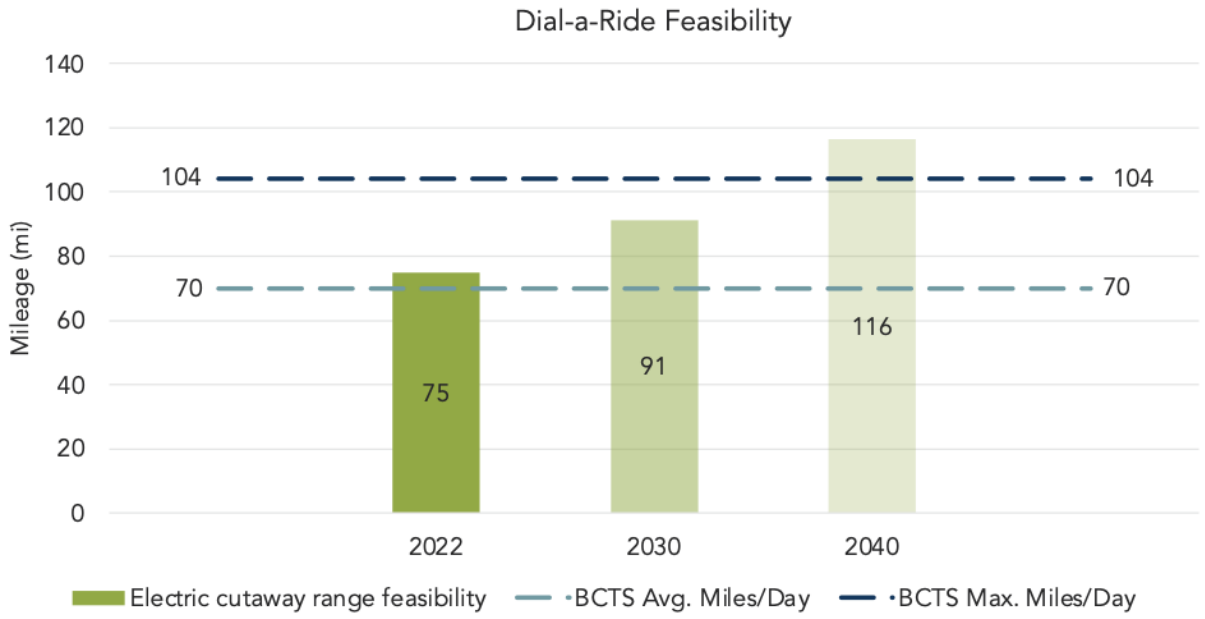

Figure 6 – Dial-a-Ride Service Feasibility by Year

Description of ZEB Technology Solutions Considered

For this study, CTE developed 3 scenarios to compare to a baseline scenario and analyze the feasibility and cost effectiveness of implementing each bus technology as well as the co-implementation of both technologies. The scenarios are referred to by the following titles and described, in detail, below. A baseline scenario was developed to represent the typical "business-as-usual" case with retention of ICE buses for cost comparison purposes.

0. Baseline (current technology)
1. BEB Only
2. Mixed Fleet – FCEB & BEBs
3. FCEB Only

In the **BEB Fleet Transition**, BEBs are purchased and deployed only on blocks that are within a BEB's achievable range as determined by CTE's modeling. If depot-charged BEBs are not capable of meeting a transit agency's daily service requirements, on-route charging is utilized on fixed-routes and returning to the depot for midday opportunity charging is used on DAR service to sustain energy on-board. Based on CTE's modeling, all of Banning Connect's blocks are fully achievable using BEB technology by 2040.

In the **Mixed Fleet Transition,** FCEBs supplement a primarily BEB fleet to make up a fully ZEB fleet. Although there may be some exceptions, due to the higher range capacity of FCEBs, BEBs will be used for DAR service and FCEBs will be used for fixed route service. The costs for infrastructure and installation of two different charging and fueling infrastructures are taken into account. FCEBs and hydrogen fuel, however, are more expensive than BEBs and electricity, so this scenario allows Banning Connect to assign the less expensive BEB technology where possible and supplement service with FCEBs as needed in support of resilience and redundancy adaptation measures.

Finally, the **FCEB Fleet Transition** was developed to examine the costs for hydrogen fueling and transitioning to a 100% FCEB fleet. A fully FCEB fleet avoids the need to install two types of fueling infrastructure by eliminating the need for depot charging equipment. Fleets composed entirely of fuel cell electric buses also offer the benefit of scalability compared to battery electric technologies. Adding FCEBs to a fleet does not necessitate large complementary infrastructure upgrades. Despite this benefit, the cost of FCEBs and hydrogen fuel are still more expensive than BEBs and electricity at current market prices.

When considering the various scenarios, this study can be used to develop an understanding of the range of costs that may be expected for Banning Connect's ZEB transition, but ultimately, can only provide an estimate. Furthermore, this study aims to provide an overview of the myriad considerations the agency must take into account in selecting a transition scenario that go beyond cost, such as space requirements, safety implications, and operational changes that may differ between scenarios.

D

Current Bus Fleet Composition and Future Bus Purchases

Fleet Assessment Methodology

The Fleet Assessment projects a timeline for the replacement of existing buses with ZEBs. The timeline is consistent with Banning Connect's fleet replacement plan that is based on the 12-year service life of transit buses and large cutaways and 7-year service life for smaller cutaways. This assessment also includes a projection of fleet capital costs over the transition timeline.

ZEB Cost Assumptions

CTE and Banning Connect developed cost assumptions for future bus purchases. Key assumptions for bus costs for the Banning Connect Transition Plan are as follows:

- CNG and gasoline vehicle prices were provided by Banning Connect and are inclusive of costs for configurable options and taxes.
- All gas cutaways were scheduled to be replaced by CNG cutaways in the baseline scenario and replacements were priced accordingly.
- Capital vehicle costs are derived from the 2022 California, Washington and New Mexico State Contracts plus the annual PPI (2%) and tax (7.75%).
- Costs for retrofits or bus conversions are not included. Procurements assume new vehicle costs.

Table 1 – Fleet Assessment Cost Assumption

	Fuel Type	
Length	CNG/Gasoline	Electric
Cutaway (26'-32')	$250,000	$298,188
35' (32'-35')	$550,000	$985,531

Description of Banning Connect's Current Fleet

Banning Connect's current service and fleet composition provide the baseline for evaluating the costs of transitioning to a zero-emission fleet. Banning Connect staff provided the following key data on current service:

- Fleet composition by powertrain and fuel
- Routes and blocks
- Mileage and fuel consumption
- Maintenance costs

Fleet

As of 2022, the Banning Connect bus fleet includes 1 CNG and 2 gasoline cutaways used for DAR paratransit service and 4 CNG buses and 2 CNG cutaways used for fixed-route service. Bus services, including fueling and maintenance, operate out of one depot in Banning, CA. Customer service operations are performed at a separate facility in Banning, CA.

Routes and Blocks

Banning Connect's 2022 service consists of 5 fixed routes run on 6 blocks, 2 run on weekends and 3 run on weekdays. Blocks range in distance from 134 miles to 307 miles. Buses pull out as early as 5:00 AM and return as late as 10:15 PM. Banning Connect's service connects the cities of Banning, Cabazon, Beaumont, and the Morongo Indian Reservation.

Current Mileage and Fuel Consumption

Annual mileage of the fleet:
251,800 miles

Banning Connect's ZEB Transition Plan assumes that the amount of service miles will remain the same.

Annual fuel consumption:
71,307 GGE of CNG and gasoline

Fleet average efficiency:
6.8 miles per GGE

BANNING CONNECT current fuel expense:
$90,453 per year

Average fuel costs:
$1.27 per GGE

Maintenance Costs

Average maintenance costs per mile by vehicle type are estimated in **Table 2**. Buses also undergo one overhaul at midlife summarized in **Table 3.** These costs were utilized to project transition maintenance costs.

Table 2 – Labor and Materials Cost Assumptions

Vehicle Type	Estimate (Per Mile)
Gas Cutaway	$ 0.35
CNG Cutaway	$ 0.35
30'/35'/40' CNG Bus	$ 0.38
Battery Electric Cutaway	$0.32
30'/35'/40' Battery Electric Bus	$0.34

Table 3 – Midlife Overhaul Cost Assumptions

Vehicle Type	Overhaul (FC/Transmission) Cost Per vehicle life	Battery Warranty Cost Per vehicle life
Gas Cutaway	$0	$0
CNG Cutaway	$0	$0
30'/35'/40' CNG Bus	$30,000	$0
Battery Electric Cutaway	$0	$24,000
30'/35' 40' Battery Electric Bus	$0	$75,000

Zero-Emission Bus Procurement Plan and Schedule

Banning Connect will provide service with a fleet made up entirely of depot-charged BEBs, while using on-route charging when able, as this vehicle composition will be sufficient for meeting the agency's service demands.

Banning Connect's fleet transition strategy is to replace each compressed natural gas (CNG) and gasoline bus with a BEB as they reach the end of their 12-year useful life beginning in 2028. Banning Connect's two CNG cutaways that are used for fixed route service are modeled as buses for the purpose of this analysis as they will need to be replaced with 35' BEBs in order to maintain the same passenger capacity**. Figure 7** below provides the number of each bus type that will be purchased each year through 2040 with this replacement strategy and the total cost of that procurement.

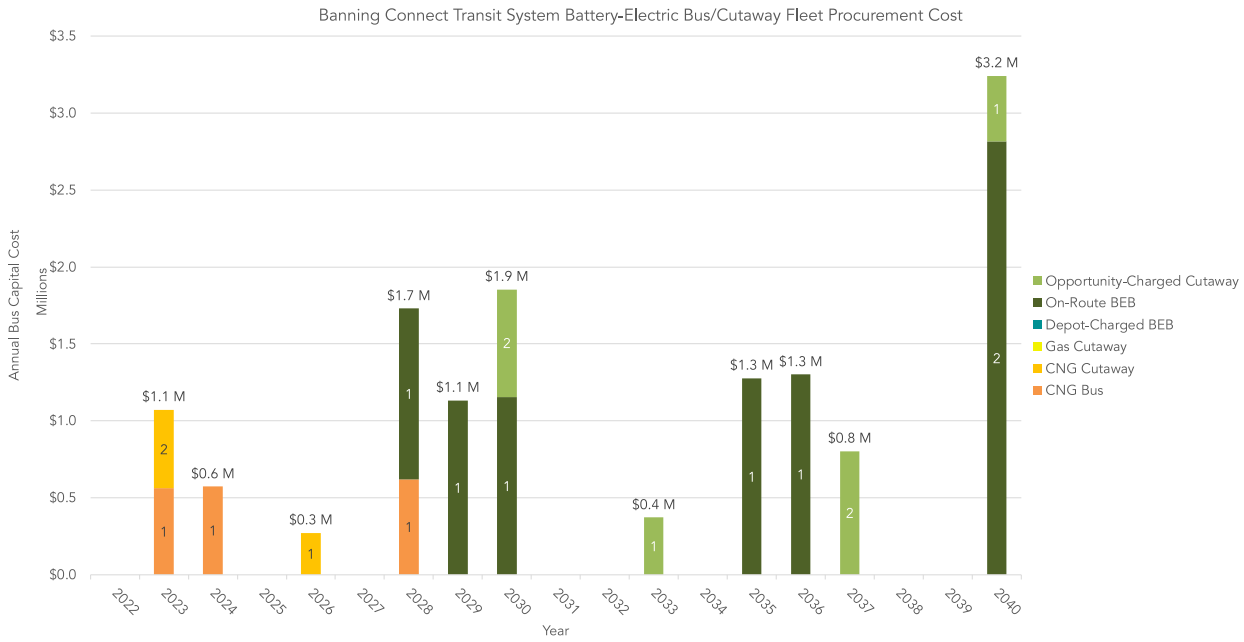

Figure 7 – Projected Fleet Procurements for Zero Emission Transition

Figure 8 demonstrates the annual composition of Banning Connect's fleet through 2040. By 2040, Banning Connect's bus fleet will consist entirely of BEBs. The fleet will remain the same size throughout the transition period.

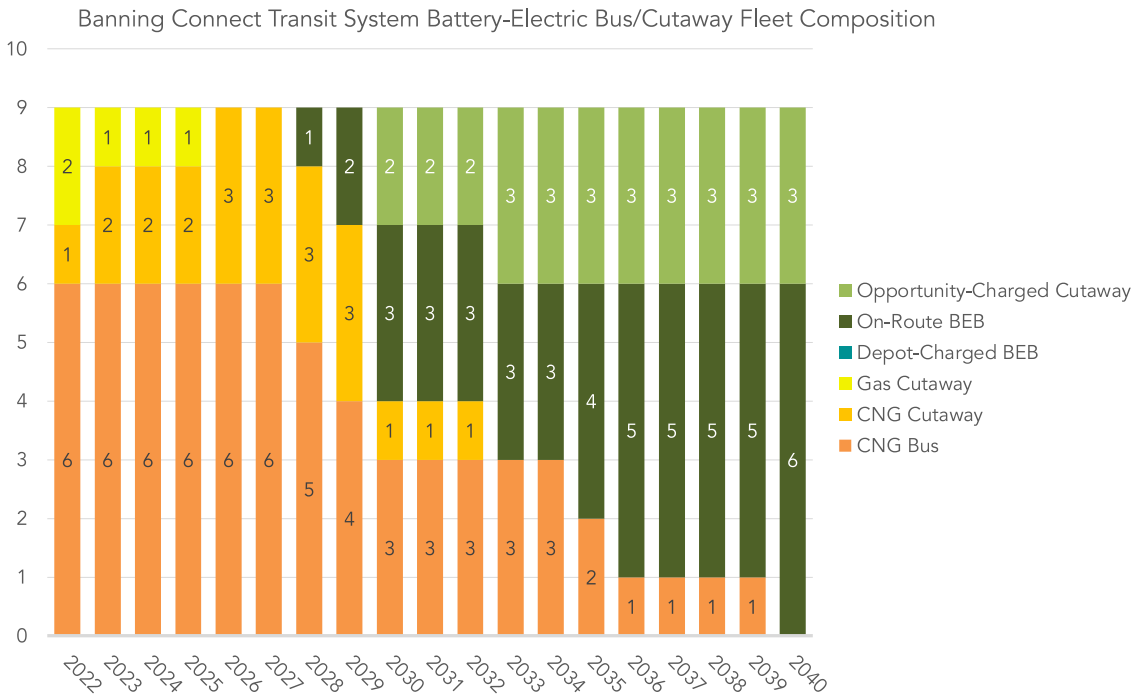

Figure 8 – Annual Fleet Composition, Zero Emission Transition

As seen in **Table 4,** the capital investment required for purchasing ZEBs is significantly higher than for CNG and Gasoline buses. This highlights the importance of staying vigilant in the search for funding opportunities to help fill this gap.

Table 4 – Banning Connect Bus Capital Investment to transition to a 100% ZEB fleet by 2040

	CNG/Gas Baseline*	ZEB Incremental Costs	Total Investment
Bus Capital Costs	$9M	$5M	$14M

*Represents the capital costs that would have been incurred in the absence of the ICT Regulation

Additional Considerations

When purchasing ZEBs, the process may differ slightly from the process Banning Connect currently uses to purchase vehicles. First, when contracting with ZEB manufacturers, Banning Connect should ensure expectations are clear between the bus OEM and the agency. As with CNG and gasoline purchases the agreement should be clear regarding the bus configurations, technical capabilities, build and acceptance process, production timing with infrastructure, warranties, training, and other contract requirements. Additionally, by developing and negotiating specification language collaboratively with the bus vendor(s), Banning Connect can work with the vendor(s) to customize the bus to their needs as much as is appropriate, help advance the industry based on agency requirements and recommended advancements, ensure the acceptance and payment process is fully clarified ahead of time, fully document the planned capabilities of the bus to ensure accountability, and generally preempt any unmet expectations. Special attention should be given in defining the technical capabilities of the vehicle, since defining these for ZEBs may differ from ICE buses.

When developing RFPs and contracting for ZEB procurements, Banning Connect should specify the source of funding for the vehicle purchases to ensure grant compliance, outline data access requirements, define the price and payment terms, establish a delivery timeline, and outline acceptance and performance requirements. Banning Connect should test the buses upon delivery for expected performance in range, acceleration, gradeability, highway performance, and maneuverability. Any such performance requirements must be included in the

technical specification portion of the RFP and contract to be binding for the OEM. Defining technical specifications for ZEBs will also differ slightly from their current CNG and gasoline vehicles since they will need to include requirements for battery performance. It is also recommended that Banning Connect purchase an extended battery warranty for the vehicles, which should be specified in the RFP and contract.

Banning Connect will also be able to apply for additional funding for these vehicles through zero-emission vehicle specific funding opportunities, which are discussed further in **Section H: Available Funding Opportunities.**

E

Facilities and Infrastructure Modifications

Banning Connect Facility Configuration and Depot Layout

Depot Address:
176 East Lincoln Street, Banning, CA 92220

Electric Utility:
Banning Electric

Located in a NOx Exempt Area?
No

Bus Parking Capacity:
9+

Current Vehicle Types Supported:
Banning Connect's depot currently supports fueling and maintenance of CNG and gasoline buses and cutaways.

Propulsion Types That Will be Supported at Completion of ZEB Transition:
Battery electric propulsion

Facilities Assessment Methodology

BEB deployments such as Banning Connect's require installation of charging stations and improvements to existing electrical infrastructure. Planning and design work, including development of detailed electrical and construction drawings required for permitting, is also necessary once specific charging equipment has been selected.

Building off of the fleet procurement schedule that was outlaid in the Fleet Assessment, CTE then uses industry average pricing to develop infrastructure scenarios that estimate the cost of building out the infrastructure necessary to support a full fleet transition to ZEBs. This plan assumes that infrastructure projects will be completed prior to each bus delivery. To project the costs of fueling infrastructure, CTE used industry pricing provided by A&E subcontractors and an infrastructure build timeline based on the procurement timeline. This plan assumes that infrastructure projects will be completed prior to each bus delivery. These projects are described in detail below.

Infrastructure Upgrade Requirements to Support Zero-Emission Buses

Description of Depot-Charging Infrastructure Considered

In the BEB-only scenario, charging infrastructure is required to service a total of three (3) battery electric cutaways and four (4) battery electric buses to support a completely zero-emission bus fleet by 2040. The total cost for battery electric fueling infrastructure is approximately $2M.

BEB Charging Infrastructure Summary

In order to support the BEB portion of the fleet, Banning Connect will need to work with a contractor to conduct detailed infrastructure planning, purchase chargers and dispensers, and add service capacity to their site. The estimated infrastructure costs for these technology & infrastructure expenses are as follows:

- **INFRASTRUCTURE PLANNING.** Building charging infrastructure requires planning at the depot. This assessment assumes that a planning project costs $200,000 and occurs only once per depot. The total cost of planning projects for Banning Connect's single depot is estimated at $200,000.
- **DISPENSERS AND CHARGERS.** Banning Connect's BEB charging depot will consist of five chargers with two dispensers per charger and one on-route charger. Prices are estimated at $170,000 for a 150kW charger with two dispensers. One transit bus per charger can charge at a time, and two cutaways can charge simultaneously at one charger, each charging at 75kW. On-Route charging equipment was also estimated to cost around $900,000 per station for design and equipment.
- **ELECTRIC SERVICE UPGRADE.** Banning Connect requires an estimated 1 MW of additional electricity capacity by 2040 to accommodate charging for 9 BEVs. To meet the growing demand for electricity, the depot will need to upgrade its system to at least 1 MW of capacity by 2027. This is estimated to cost around $200,000 over the transition period.
- **INFLATION FACTOR.** 5.4% inflation is added on all project costs per the CPI. 3% inflation is added on all maintenance costs per industry standards. All costs listed above are in 2022 dollars, projects occurring after 2022 are inflated per the inflation factor.

The estimated total BEB infrastructure cost for the BEB scenario is shown below in **Figure 9.** totaling to approximately $2 M over the transition period.

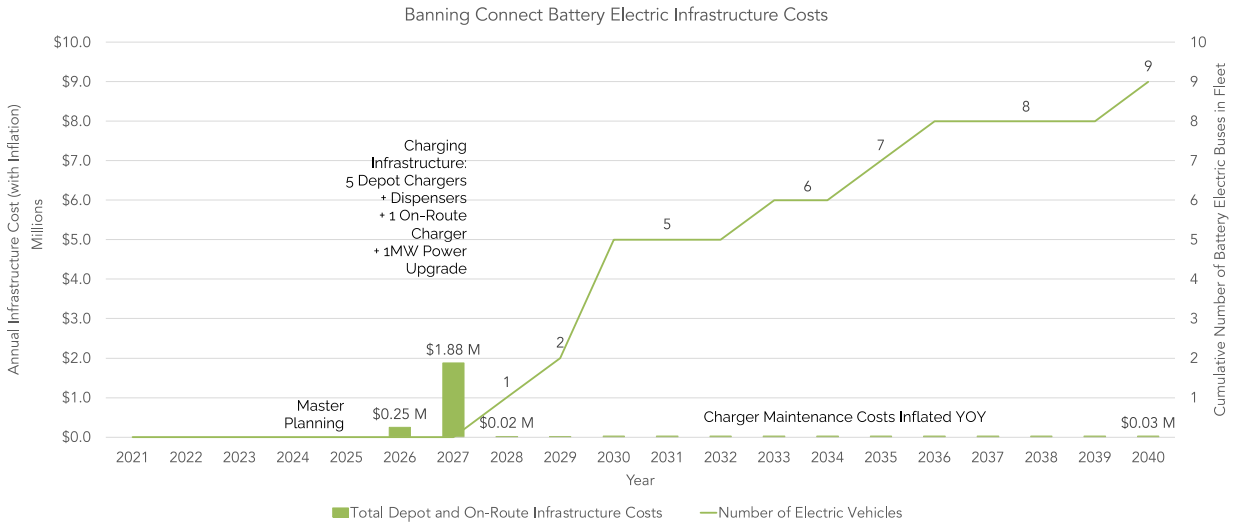

Figure 9 – Infrastructure Project and Costs, ZEB Transition

Utility Partnership Review

The City is sharing proposed planning documents to help Banning Electric understand future loads so that any required grid infrastructure improvements can be addressed prior to implementation. The City's discussion of short- and long-term fleet goals with Banning Electric will ensure that Banning Electric can properly plan grid-side electrical infrastructure upgrades to the City's Corporation Yard, and that the City can adequately upgrade equipment to support battery electric buses. Once the infrastructure upgrade needs are established, the City will incorporate the design and construction timelines into the overall transition plan timeline. The City recognizes

Banning Electric as a critical partner in electrification and will continue to partner with Banning Electric after the planning stages so that charge management strategies and fleet expansion efforts can be coordinated effectively.

F

Providing Service in Disadvantaged Communities

Providing Zero-Emission Service to DACs

In California, CARB defines disadvantaged communities (DACs) as communities that are both socioeconomically disadvantaged and environmentally disadvantaged due to local air quality. Lower income neighborhoods are often exposed to greater vehicle pollution levels due to proximity to freeways and the ports, which puts these communities at greater risk of health issues associated with tailpipe emissions.[9] ZEBs will reduce energy consumption, harmful emissions, and direct carbon emissions within the disadvantaged communities Banning Connect serves. The City of Banning includes one census tract designated as a DAC. Banning's fixed routes that are in and pass through DACs, along with their stops are shown in **Figure 10** below.

Environmental impacts, both from climate change and from local pollutants, disproportionately affect transit riders. For instance, poor air quality from tailpipe emissions and extreme heat harm riders waiting for buses at roadside stops. The transition to zero-emission technology will benefit the region by reducing fine particulate pollution and improving overall air quality. In turn, the fleet transition will support better public health outcomes for residents in DACs served by the selected routes.

Public transit has the potential to improve social equity by providing mobility options to low-income residents lacking access to a personal vehicle and helping to meet their daily needs. In California, transit use is closely correlated with car-less households as they are five times more likely to use public transit than households with at least one vehicle.[10] Although 21% of Californians in a zero-vehicle household are vehicle free by choice, 79% do not have a vehicle due to financial limitations. Many low-income people therefore rely solely on public transportation for their mobility needs.[11] Banning Connect's current fleet of fixed route and DAR CNG and gasoline buses consume 71,308 Gasoline Gallons Equivalent (GGE) of fuel per year, operating for approximately 251,800 miles per year. Moving Banning Connect's fleet to zero-emission technology will help alleviate the pollution from tailpipe emissions, which will improve the health of communities impacted by NOx and particulate matter emissions and all local communities.

Access to quality transit services provides residents with a means of transportation to go to work, to attend school, to access health care services, and run errands. By purchasing new vehicles and decreasing the overall age of its fleet, Banning Connect is also able to improve service reliability and therefore maintain the capacity to serve low-income and disadvantaged populations. Replacing CNG and diesel gasoline vehicles with zero-emission vehicles

---

[9] Reichmuth, David. 2019. Inequitable Exposure to Air Pollution from Vehicles in California. Cambridge, MA: Union of Concerned Scientists. https://www.ucsusa.org/resources/inequitable-exposure-air-pollution-vehicles-california-2019

[10] Grengs, Joe; Levine, Jonathan; and Shen, Qingyun. (2013). Evaluating transportation equity: An inter-metropolitan comparison of regional accessibility and urban form. FTA Report No. 0066. For the Federal Transit Administration

[11] Paul, J & Taylor, BD. 2021. Who Lives in Transit Friendly Neighborhoods? An Analysis of California Neighborhoods Over Time. Transportation Research Interdisciplinary Perspectives. 10 (2001) 100341. https://reader.elsevier.com/reader/sd/pii/S2590198221000488?token=CABB49E7FF438A88A19D1137A2B1851806514EF576E9A2D9462D3FAF1F628357490756251970 9F8AD53DEC3CF95ACF27&originRegion=us-east-1&originCreation=20220216190930

will also benefit these populations by improving local air quality and reducing exposure to harmful emissions from CNG and gasoline exhaust.

Map of Disadvantaged Communities served by Banning Connect

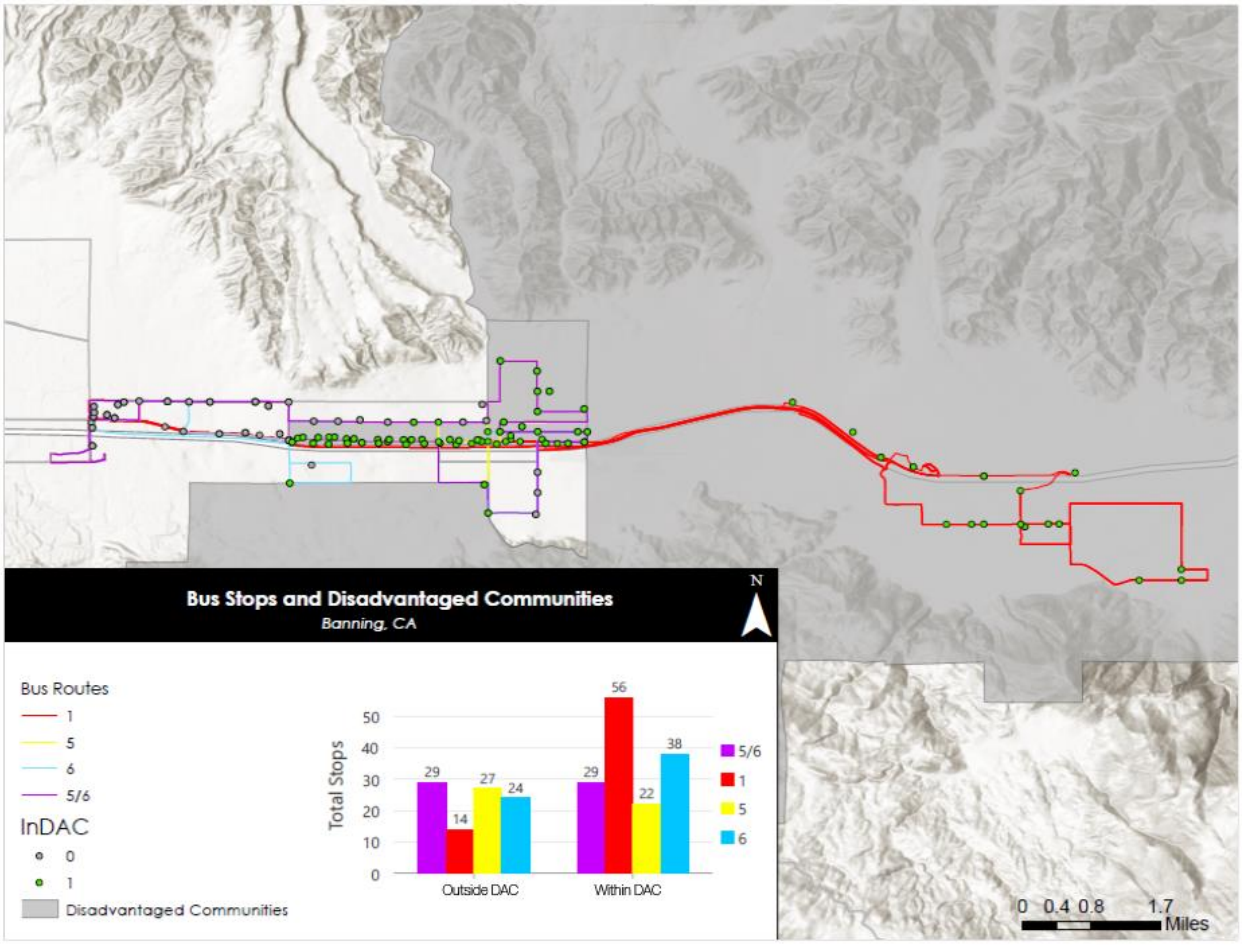

Figure 10 – Banning Connect Disadvantaged Communities Service Map

Emissions Reductions for DACs

Greenhouse gasses (GHG) are the compounds primarily responsible for atmospheric warming and include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The effects of greenhouse gasses are not localized to the immediate area where the emissions are produced. Regardless of their point of origin, greenhouse gasses contribute to overall global warming and climate change.

Criteria pollutants include carbon monoxide (CO), nitrogen oxides (NOx), particulate matter under 10 and 2.5 microns (PM_{10} and $PM_{2.5}$), volatile organic compounds (VOC), and sulfur oxides (SO_X). These pollutants are considered harmful to human health because they are linked to cardiovascular issues, respiratory complications, or other adverse health effects.[12] These compounds are also commonly responsible for acid rain and smog. Criteria

[12] Institute of Medicine. Toward Environmental Justice: Research, Education, and Health Policy Needs. Washington, DC: National Academy Press, 1999; O'Neill MS, et al. Health, wealth, and air pollution: Advancing theory and methods. Environ Health Perspect. 2003; 111: 1861-1870; Finkelstein et al. Relation between income, air pollution and mortality: A cohort study.

pollutants cause economic, environmental, and health effects locally where they are emitted. CARB defines DACs in part as disadvantaged by poor air quality because polluting industries or freight routes have often been cited in these communities. The resulting decrease in air quality has led to poorer health and quality of life outcomes for residents. Banning Connect's operational Well-to-Wheel criteria emissions are summarized in **Table 5.**

Table 5 – Annual Vehicle Operation Pollutants by Fuel Type

Overall Annual Vehicle Operation Pollutants (lbs.)								
Bus Group	**CO**	**NOx**	**PM10**	**PM2.5**	**VOC**	**SOx**	**PM10 TBW**	**PM2.5 TBW**
CNG	10,444	382.6	3.8	3.5	40.6	3.8	48.2	6.2
Gas	908	7.2	0.7	0.6	16.0	0.5	4.7	0.6

The transportation sector is the largest contributor to greenhouse gas emissions in the United States, accounting for more than 30% of total emissions, and within this sector, 25% of these emissions come from the medium- and heavy-duty markets, yet these markets account for less than 5% of the total number of vehicles. Electrifying these vehicles can have an outsized impact on pollution, fossil-fuel dependency, and climate change. ZEBs are four times more fuel efficient than comparable new Internal Combustion Engine (ICE) buses. Better fuel efficiency means less waste when converting the potential energy in the fuel to motive power. Less waste not only means less pollution, it results in more efficient use of natural resources. By transitioning to ZEBs from CNG and gasoline buses, Banning Connect's zero-emission fleet will produce fewer carbon emissions and fewer harmful pollutants from the vehicle tailpipes. Considering DACs experience significantly more pollution from harmful emissions, communities disadvantaged by pollution served by Banning Connect's fleet will therefore directly benefit from the reduced tailpipe emissions of ZEBs compared to ICE buses.

Estimated Ridership in DACs

As shown in **Figure 10**, of all the fixed-route stops, 73 (67%) are located within DACs. In addition, much of the DAR service area provided for Seniors 60 and older; persons with disabilities; and persons certified under the Americans with Disability Act (ADA) falls within DAC zones, but specific trips may start and/or end outside of DAC-designated areas. This includes ADA services within three-quarters of a mile of fixed-route service. Unlike fixed-route service, the DAR service does not run a set route, and so a single vehicle may provide trips both within and outside of a DAC during a single day.

CMAJ. 2003; 169: 397-402; Zeka A, Zanobetti A, Schwartz J. Short term effects of particulate matter on cause specific mortality: effects of lags and modification by city characteristics. Occup Environ Med. 2006; 62: 718-725.

G

Workforce Training

Banning Connect's Current Training Program

Operator, Dispatcher and Mechanic Training

Banning Connect staff works closely with the OEM providing vehicles to ensure all mechanics, service employees, and bus operators complete necessary training prior to deploying a new vehicle type and that these staff undergo refresher training annually and as needed. Management stays abreast of regulatory requirements and ensures that associated training takes place during annual VTT training or sooner. Banning Connect staff also brings up any issues or questions they may have about their training with their respective trainers.

Banning Connect's ZEB Training Plan

OEM Training

Banning Connect plans to take advantage of trainings from the bus manufacturers and station suppliers, including maintenance and operations training, station operations and fueling safety, first responder training and other trainings that may be offered by the technology providers. OEM trainings provide critical information on operations and maintenance aspects specific to the equipment model procured. Additionally, many procurement contracts include train-the-trainer courses through which small numbers of agency staff are trained and subsequently train agency colleagues. This method provides a cost-efficient opportunity to provide widespread agency training on new equipment and technologies.

Bus and Fueling Operations and Maintenance

The transition to a zero-emission fleet will have significant effects on Banning Connect's workforce. Meaningful investment is required to upskill maintenance staff and bus operators trained in ICE vehicle maintenance and ICE fueling infrastructure.

Banning Connect training staff will work closely with the OEM providing vehicles to ensure all mechanics, service employees, and bus operators complete necessary training prior to deploying ZEB technology and that these staff undergo refresher training annually and as needed. Banning Connect staff will also be able to bring up any issues or questions they may have about their training with their trainers. Additionally, trainers will observe classes periodically to determine if any staff would benefit from further training.

ZEB Training Programs

Several early ZEB adopters have created learning centers for other agencies embarking on their ZEB transition journeys. One such agency is SunLine Transit Agency, which provides service to the Coachella Valley and hosts the West Coast Center of Excellence in Zero Emission Technology (CoEZET). The Center of Excellence supports transit agency adoption, zero-emission commercialization and investment in workforce training. Similarly, AC Transit

offers training courses covering hybrid and zero-emission technologies through their ZEB University program. Banning Connect plans to take advantage of these trainings offered by experienced agencies.

There are several transit agencies within and around Riverside County that have successfully begun their transition to zero-emission technology. In the region, Omintrans, a public transit agency serving the San Bernardino Valley recently received $9.3 million from the Federal Transit Administration (FTA) under the FY2022 Low-No Emission Vehicle Program to develop hydrogen refueling infrastructure and launch a workforce development program. These agencies can serve a resource for Banning Connect to use when implementing zero-emission technology and supporting programs into their services.

H

Potential Funding Sources

Available Funding Opportunities

Federal

Banning Connect is ineligible for most federal funds apart from Federal Highway Administration Funds (FHWA). Banning is planning to pursue funding opportunities administered by the Federal Highway Administration such as the following:

- Federal Highway Administration (FHWA)
    - Congestion Mitigation and Air Quality Improvement Program through SCAG
    - Surface Transportation Block Grant Program through SCAG
    - Carbon Reduction Program

State

CCTS will also seek funding from state resources through grant opportunities including but not limited to Senate Bill 1 State of Good Repair (SGR), Transit and Intercity Rail Capital Program (TIRCP), Low Carbon Transit Operations Program (LCTOP) funding, the California Energy Commission's Clean Transportation Program as well as Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) for bus purchases when available.

Annual Reliable Funding

- Administered by California Department of Transportation (Caltrans)
    - Transportation Development Act Funds
        - Local Transportation Funds
        - State Transit Assistance (STA)
    - State of Good Repair (SB 1 funds)
    - Low Carbon Transit Operations Program (LCTOP)

Future Funding Opportunities

- California Air Resources Board (CARB)
    - Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)
    - State Volkswagen Settlement Mitigation
    - Carl Moyer Memorial Air Quality Standards Attainment Program
    - Cap-and-Trade Funding
    - Low Carbon Fuel Standard (LCFS)
- California Transportation Commission (CTC)
    - State Transportation Improvement Program (STIP)
    - Solution for Congested Corridor Programs (SCCP)
    - Local Partnership Program (LPP)
- California Department of Transportation (Caltrans)
    - Transit and Intercity Rail Capital Program
    - Transportation Development Credits
    - New Employment Credit

- California Energy Commission

Local

Additionally, Banning Connect will pursue local funding opportunities to support zero-emission bus deployment. While the aforementioned funding opportunities are mentioned by name, Banning Connect will not be limited to these sources and will regularly assess opportunities for fiscal support for the ZEB program.

Legislation Supporting the Zero-Emission Transition

Policies and regulations supporting the transition to zero-emission are proliferating as the efforts to decarbonize the transportation sector expand. The city of Banning is monitoring the implementation of relevant policies and legislation. With the passage of the *Bipartisan Infrastructure Law* and issuance of *Executive Order 14008: Tackling the Climate Crisis at Home and Abroad*, the federal government has set a renewed focus on zero-emission transit. Riverside County's goal to deploy zero-emission vehicles supports the federal administration's priorities of renewing transit systems, reducing Greenhouse Gas emissions from public transportation, equity, creation of good paying jobs, and connecting communities. State legislation such as the Innovative Clean Transit Regulation further supports the replacement of fossil-fuel vehicles on the roads of California. Moreover, on August 25, 2022, the CARB approved the Advanced Clean Cars II Rule, requiring all new vehicles sold in California to be zero-emission vehicles (ZEVs) by 2035.

Start-up and Scale-up Challenges

Financial Challenges

Challenges can arise with any new propulsion technology, its corresponding infrastructure, or in training operators and maintenance staff. Nearly all transit agencies must contend with the cost barriers posed by zero-emission technologies. The current market cost of ZEBs is between $980,000 and $1,310,000, which is about $320,000 to $650,000 more costly than traditional ICE buses. The predicted costs of zero-emission cutaways are between $300,000 and $370,000, which is about $120,000 and $200,000 more costly than traditional ICE cutaways.

Additionally, the necessary infrastructure to support these buses adds to the financial burden of transitioning to a ZEB fleet, as outlined below in **Table 6** showing the cost of the transition to BEB-only fleet. Banning Connect will seek financial support to cover the cost of their BEBs from the resources discussed in Section H.

Table 6 – Incremental Cost of ZEB Transition

Incremental cost of ZEB Transition			
	CNG/Gas Baseline*	BEB Incremental Costs	BEB Transition Scenario Costs
Bus Capital Expense	$9M	$5M	$14M
Fueling Infrastructure	$0	$2M	$2M
Total	$9M	$7M	$16M

*Represents the capital costs that would have been incurred in the absence of the ICT Regulation

As seen in **Table 6**, the costs of required fueling infrastructure and fueling operations for ZEB technologies pose another hurdle for transit agencies transitioning to zero-emission service. Continued financial support at the local, state and federal level to offset the capital cost of this new infrastructure is imperative. For alternative fuels such as hydrogen, financial support from state and federal grant opportunities for green hydrogen supply chains and increasing economies of scale on the production side will ultimately benefit transit agencies deploying and planning for BEBs.

CARB can support Banning Connect by ensuring continued funding for the incremental cost of zero-emission buses and fueling infrastructure. Funding opportunities should emphasize proper transition and deployment planning and should not preclude hiring consultants to ensure best practices and successful deployments.

Limitations of Current Technology

Beyond cost barriers, transit agencies must also ensure that available zero-emission technologies can meet basic service requirements of the agency's duty cycles. The applicability of specific zero-emission technologies will vary widely among service areas and agencies. As such, it is critical that transit agencies in need of technical and planning support have access to these resources to avoid failed deployment efforts. Support in the form of technical consultants and experienced zero-emission transit planners will be critical to turning Rollout Plans into successful deployments and tangible emissions reductions.

In addition to the uncertainty of technology improvements, there are other risks to consider in trying to estimate costs over the 18-year transition period. Although current BEB range limitations may be improved over time as a result of advancements in battery energy capacity and more efficient components, battery degradation may re-

introduce range limitations, which is a cost and performance risk to an all-BEB fleet over time. While this can be mitigated by on-route charging, there may be emergency scenarios where the buses are expected to perform off-route or atypical service. In these emergency scenarios that require use of BEBs, agencies may face challenges performing emergency response roles expected of them in support of fire and police operations. Furthermore, fleetwide energy service requirements, power redundancy, and resilience may be difficult to achieve at any given depot in an all-BEB scenario. Although FCEBs may not be subject to these same limitations, higher capital equipment costs and availability of hydrogen may constrain FCEB solutions. RCTC, Banning Connect, CTE and Arcadis IBI Group will expand upon challenge mitigation and adaptation in the Riverside County ZEB Implementation & Financial Strategy Plan.

Appendix A – Approved Board Resolution

Appendix B – Glossary

Auxiliary Energy: Energy consumed (usually as a by time measure, such as “x”kW/hour) to operate all support systems for non-drivetrain demands, such as HVAC and interior lighting.

Battery Electric Bus: Zero-emission bus that uses onboard battery packs to power all bus systems.

Battery Nameplate Capacity: The maximum rated output of a battery under specific conditions designated by the manufacturer. Battery nameplate capacity is commonly expressed in kWh and is usually indicated on a nameplate physically attached to the battery.

Block: Refers to a vehicle schedule, the daily assignment for an individual bus. One or more runs can work a block. A driver schedule is known as a “run.”

Charging Equipment: The equipment that encompasses all the components needed to convert, control and transfer electricity from the grid to the vehicle for the purpose of charging batteries. May include chargers, controllers, couplers, transformers, ventilation, etc.

Depot Charging: Centralized BEB charging at a transit agency's garage, maintenance facility, or transit center. With depot charging, BEBs are not limited to specific routes, but must be taken out of service to charge.

Energy: Quantity of work, measured in kWh for ZEBs.

Energy Efficiency: Metric to evaluate the performance of ZEBs. Defined in kWh/mi for BEBs, mi/kg of hydrogen for FCEBs, or miles per diesel gallon equivalent for any bus type.

Fuel Cell Electric Bus: Zero-emission bus that utilizes onboard hydrogen storage, a fuel cell system, and batteries. The fuel cell uses hydrogen to produce electricity, with the waste products of heat and water. The electricity powers the batteries, which powers the bus.

Greenhouse Gas Emissions: Zero-emission buses have no harmful emissions that result from diesel combustion. Common GHGs associated with diesel combustion include carbon dioxide (CO2), carbon monoxide (CO), nitrous oxides (NOx), volatile organic compounds (VOCs), and particulate matter (PM). These emissions negatively impact air quality and contribute to climate change impacts.

Hydrogen Fueling Station: The location that houses the hydrogen production (if produced onsite), storage, compression, and dispensing equipment to support fuel cell electric buses.

On-route Charging: BEB charging while on the route. With proper planning, on-route charged BEBs can operate indefinitely, and one charger can charge multiple buses.

Operating Range: Driving range of a vehicle using only power from its electric battery pack to travel a given driving cycle.

Route Modeling: A cost-effective method to assess the operational requirements of ZEBs by estimating the energy consumption on various routes using specific bus specifications and route features.

Useful Life: FTA definition of the amount of time a transit vehicle can be expected to operate based on vehicle size and seating capacity. The useful life defined for transit buses is 12-years. For cutaways, the useful life is 7 years.

Validation Procedure: to confirm that the actual bus performance is in line with expected performance. Results of validation testing can be used to refine bus modeling parameters and to inform deployment plans. Results of validation testing are typically not grounds for acceptance or non-acceptance of a bus.

Zero-Emission Vehicle: A vehicle that emits no tailpipe emissions from the onboard source of power. This is used to reference battery-electric and fuel cell electric vehicles, exclusively, in this report.

Well-to-wheel Emissions: Quantity of greenhouse gas, criteria pollutants, and/or other harmful emissions that includes emissions from energy use and emissions from vehicle operation. For BEBs, well-to-wheel emissions would take into account the carbon intensity of the grid used to charge the buses. For FCEBs, well-to-wheel emissions would take into account the energy to produce, transport, and deliver the hydrogen to the vehicle

RESOLUTION 2023-91

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF BANNING, CALIFORNIA, APPROVING THE ZERO-EMISSION BUS ROLLOUT PLAN AND AUTHORIZING THE SUBMISSION OF SAID PLAN TO THE CALIFORNIA AIR RESOURCES BOARD (CARB) AS REQUIRED BY THE INNOVATIVE CLEAN TRANSIT REGULATION

WHEREAS, in 2018, California Air Resources Board (CARB) adopted the Innovative Clean Transit (ICT) Regulation, which requires public transit agencies to gradually transition to a 100 percent Zero Emission Bus (ZEB) fleet with a goal for full transition by 2040; and

WHEREAS, each transit agency must adopt and submit to CARB a ZEB Rollout Plan describing how the Agency will transition to a zero-emission fleet; and

WHEREAS, the City of Banning's ZEB Rollout Plan must be submitted to CARB by July 1, 2023; and

WHEREAS, per the requirements of the OCT, the Rollout Plan includes required information from the following sections:

Section A: Transit Agency Information
Section B: Rollout Plan General Information
Section C: Technology Portfolio
Section D: Current Bus Fleet Composition and Future Bus Purchases
Section E: Facilities and Infrastructure Modifications
Section F: Providing Service in Disadvantaged Communities
Section G: Workforce Training
Section H: Potential Funding Sources; and

WHEREAS, the Rollout Plan is a living document intended to guide the Agency's conversion to a ZEB fleet and may be updated based on changes in vehicle technology, fleet size and operating requirements; and

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Banning as follows:

SECTION 1. City Council hereby approves the City of Banning's Zero-Emission Rollout Plan and authorizes it's submittal to CARB.

SECTION 2. The City Clerk shall certify the adoption of this Resolution and shall cause a certified resolution to be filed in the book of original resolutions.

PASSED, APPROVED AND ADOPTED this 23rd day of May 2023.

Alberto Sanchez, Mayor
City of Banning

ATTEST:

Caroline Patton, Deputy City Clerk
City of Banning

APPROVED AS TO FORM AND LEGAL CONTENT:

Serita Young, City Attorney

CERTIFICATION:

I, Caroline Patton, Deputy City Clerk of the City of Banning, California, do hereby certify that the foregoing Resolution 2023-91, was duly adopted by the City Council of the City of Banning, California, at a regular meeting thereof held on the 23rd day of May 2023 by the following vote, to wit:

AYES: Flynn, Sanchez, and Wallace.

NOES:

ABSENT: Gonzales and Minjares.

ABSTAIN:

Caroline Patton, Deputy City Clerk
City of Banning, California