RESOLUTION NO. 2024- R ______________

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF CULVER CITY, CALIFORNIA, APPROVING THE UPDATE TO THE CULVER CITYBUS INNOVATIVE CLEAN TRANSIT (ICT) ROLLOUT PLAN.

WHEREAS, in 2018, the California Air Resources Board (CARB) adopted the Innovative Clean Transit (ICT) Regulation, which requires public transit agencies to transition to a 100 percent zero-emission bus (ZEB) fleet, such as battery-electric or fuel cell electric, by 2024; and

WHEREAS, the City Council adopted the current Culver City Battery Electric Bus Transportation Facility Electrification Transition Plan (Rollout Plan) on September 20, 2021, which contained the plan for transition of the City bus fleet to 100% zero emission fleet; and,

WHEREAS, The Rollout Plan was intended to function as a living document, subject to amendment and change as circumstances and opportunities changed over time; and

WHEREAS, the City's consultant on the Rollout Plan, the Center for Transportation and Environment (CTE) has recommended comprehensive changes to the Rollout Plan, reflected in the amended Rollout Plan attached as Exhibit A to this resolution.

NOW, THEREFORE, the City Council of the City of Culver City DOES HEREBY RESOLVE as follows:

1. The City Council, as the governing body of the City of Culver City (which includes Culver CityBus, a small public transit agency), hereby approves the

Updated Culver City Battery Electric Bus Transportation Facility Electrification Transition Plan (Rollout Plan) attached to this Resolution as Exhibit A.

2. The City of Culver City is authorized to comply with all conditions and requirements set forth in the Innovative Clean Transit (ICT) regulation adopted by the California Air Resources Board (CARB) and codified at Cal. Code Regs., tit. 13 §§ 2023, 2023.1-2023.11.

3. The City Manager or designee is authorized to execute and cause to be submitted to the CARB all documents required for Culver CityBus to comply with the ICT regulation.

APPROVED and ADOPTED this _____ day of __________ 2024.

____
YASMINE-IMANI, Mayor
City of Culver City, California

ATTEST:

____
JEREMY BOCCHINO, City Clerk

APPROVED AS TO FORM:

____
HEATHER S. BAKER, City Attorney

Exhibit A

CENTER FOR TRANSPORTATION AND THE ENVIRONMENT

Culver CityBus ICT Rollout Plan

Prepared by Culver CityBus with support from the Center for Transportation and the Environment

Table of Contents

COVER PAGE

....1

LIST OF TABLES 4

LIST OF FIGURES...4

LIST OF ABBREVIATIONS 5

EXECUTIVE SUMMARY 6

A 8

TRANSIT AGENCY INFORMATION 8

CULVER CITYBUS BACKGROUND INFORMATION 8
ABOUT CITYBUS...9
CITYBUS' ZERO-EMISSION BUS MISSION...9

B 10

ROLLOUT PLAN GENERAL INFORMATION 10

OVERVIEW OF THE INNOVATIVE CLEAN TRANSIT REGULATION 10
CITYBUS'S ROLLOUT PLAN GENERAL INFORMATION...10
Rollout Plan as a Living Document *11*

C 12

TECHNOLOGY PORTFOLIO..12

ZERO-EMISSION BUS TECHNOLOGY SELECTION 12
ZEB Transition Planning Methodology *12*
Requirements Analysis & Data Collection *13*
Service Assessment.. *14*
Why a Mixed Fleet? *15*

D 17

CURRENT BUS FLEET COMPOSITION AND FUTURE BUS PURCHASES 17

FLEET ASSESSMENT METHODOLOGY 17
ZEB COST ASSUMPTIONS 17
Fleet *18*
Routes and Blocks.. *19*
Current Mileage and Fuel Consumption.. *19*

Zero-Emission Bus Procurement Plan and Schedule ... 20
PROJECTED ANNUAL CAPITAL COSTS FOR ZEB PURCHASES ... 22
Fuel Costs ... 24
Maintenance Costs ... 26
E ... 28
FACILITIES AND INFRASTRUCTURE MODIFICATIONS ... 28
CITYBUS CURRENT YARD DESCRIPTION ... 28
FACILITIES ASSESSMENT METHODOLOGY ... 28
Infrastructure: Cost Summary ... 29
DESCRIPTION OF CHANGES TO PARKING REQUIREMENTS ... 30
F ... 32
PROVIDING SERVICE IN DISADVANTAGED COMMUNITIES ... 32
PROVIDING SERVICE TO DACS ... 32
Map of CityBus Service in DACs ... 33
Zero-Emission Service for DACs ... 33
G ... 35
WORKFORCE TRAINING ... 35
CITYBUS' CURRENT TRAINING PROGRAM ... 35
CITYBUS'S ZEB TRAINING PLAN ... 36
OEM Training ... 36
H ... 37
POTENTIAL FUNDING SOURCES ... 37
SOURCES OF FUNDING FOR ZEB TRANSITION ... 37
FEDERAL ... 37
STATE ... 37
LOCAL ... 38
I ... 39
START-UP AND SCALE-UP CHALLENGES ... 39
FINANCIAL CHALLENGES ... 39
LIMITATIONS OF CURRENT TECHNOLOGY ... 39
APPENDIX A – APPROVED BOARD RESOLUTION ... 41

List of Tables

Table 1 - ICT ZEB Percentage Requirements 6
Table 2 – Fleet Assessment Cost Assumptions 18
Table 3 – CityBus Bus Capital Investment to transition to a 100% ZEB fleet by 2040 23
Table 4 - Fuel Cost Assumptions 24
Table 5 - Electricity Cost Assumptions 24
Table 6 - Maintenance Cost Assumptions- Parts & Labor 26
Table 7 – Facilities Cost Assumptions- Charger and Installation Costs 29
Table 8 – Facilities Cost Assumptions- Hydrogen Fueling Facility Options 29
Table 9 - CityBus Infrastructure Capital Investment to transition to a 100% ZEB fleet by 2040 30
Table 10 – Fleet Transition Emissions Benefits 34
Table 11 – Incremental Cost of CityBus' ZEB Transition (2021-2040) 39

List of Figures

Figure 1 - Battery and Fuel Cell Electric Bus Schematic 7
Figure 2 – BEB Block Achievability Percentage by Year 15
Figure 3 – Projected Bus Purchases 20
Figure 4 - Annual Fleet Composition 21
Figure 5 - Annual Capital Costs 22
Figure 6 - Mixed Fleet Fuel Cost 25
Figure 7 – Mixed Fleet Maintenance Cost 27
Figure 8 - BEB and FCEB Infrastructure Costs 30
Figure 9 – Map of DAC's in CityBus Service Area 33

List of Abbreviations

A&E: Architecture and Engineering

BEB: Battery Electric Bus

CARB: California Air Resources Board

CityBus: Culver CityBus

CNG: Compressed Natural Gas

CTE: Center for Transportation and the Environment

DAC: Disadvantaged Community(ies)

FCEB: Fuel Cell Electric Bus

HVAC: Heating, Ventilation, and Air Conditioning

ICE: Internal Combustion Engine

ICT: Innovative Clean Transit

kW: Kilowatt

kWh: Kilowatt Hour

LA: Los Angeles

LAX: Los Angeles International Airport

MW: Megawatt

PPI: Producer Price Index

RCNG: Renewable Compressed Natural Gas

SCE: Southern California Edison (SoCal Edison)

UCLA: University of California Los Angeles

ZEB: Zero-Emission Bus

Executive Summary

Culver City, spanning 5 square miles on the Westside of the Los Angeles County, is a key regional mobility service provider through its fixed-route transit service. The municipally owned and operated Culver CityBus service integrates seamlessly with the regional rail network, providing vial connections to five rail stations and three major bus hubs, serving over 4.6 million passengers (pre-pandemic) with a fleet of 54 buses. Culver CityBus operates seven local fixed-route bus lines and one bus rapid transit (BRT) line. Seven of the eight routes connect directly with at least one rail station. Culver CityBus is also one of the most affordable transit providers in the region, offering fares as low as $1, making it a cost-effective choice for riders.

Culver City is dedicated to implementing environmentally friendly policies and reducing its carbon footprint. As part of this initiative, the City plans to transition to full CityBus zero-emission by 2040. Based on the Center for Transportation and the Environment (CTE) analysis, Culver City will be able to achieve an entirely zero-emission fleet by 2040, which is in line with the Innovative Clean Transit (ICT) Regulation. Based on CTE's analysis, Culver City has concluded that fleet electrification is achievable through the use of both battery electric and fuel cell technologies. The City will replace its renewable compressed natural gas (CNG) buses with zero-emission buses (ZEBs) when the CNG buses reach the end of their 12-year useful life. Supporting a fully ZEB fleet will require upgrades to Culver CityBus' yard, including charging, hydrogen refueling, and gantry structures in Culver CityBus's yard, as well as additional facility space to allow for the necessary fueling equipment.

Culver City's bus service provides vital transportation for numerous Disadvantaged Communities (DAC)s, and the transition to zero-emission buses will help improve the health of DACs and non-DACs alike. The agency plans to provide the necessary ZEB-specific training that will be required for the agency to own and operate ZEBs. Culver City plans to pursue government funding at the federal, state, and local levels. The agency estimates that pursuing a ZEB fleet in place of a RCNG fleet will cost an additional $180,000,000 in bus and infrastructure costs alone between 2021 and 2040, underscoring the need for substantial funding opportunities. This estimate does not include the cost of acquiring additional yard space.

On December 14, 2018, CARB enacted the ICT regulation, setting a goal for California public transit agencies to have 100% zero-emission fleets by 2040. The ruling specifies the percentage of new bus procurements that must be zero-emission buses for each year of the transition period (2021– 2040). Those annual percentages are outlined in **Table 1** below.

Table 1 - ICT ZEB Percentage Requirements

Starting January 1	Percent of New Bus Purchases for Small Agencies
2026	25%
2027	25%
2028	25%
2029	100%

This schedule lays out a pathway to reaching 100% zero-emission fleets in 2040 based on a 12-year projected lifespan for a transit bus. Culver City has the opportunity to request waivers that allow purchase deferrals in the event of economic hardship or if zero-emission technology has not matured enough to 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 lifecycle basis and that zero-emission technology may not currently be able to meet all service requirements.

Zero-emission technologies considered in this study include battery-electric buses (BEB) and hydrogen fuel cell electric buses (FCEB). BEBs and FCEBs have similar electric drive systems that feature a traction motor powered by a battery. The primary differences between BEBs and FCEBs are the respective amount of battery storage and the method by which the batteries are recharged. The electric drive components and energy source for a BEB and FCEB are illustrated in **Figure 1** - Battery and Fuel Cell Electric Bus Schematic.

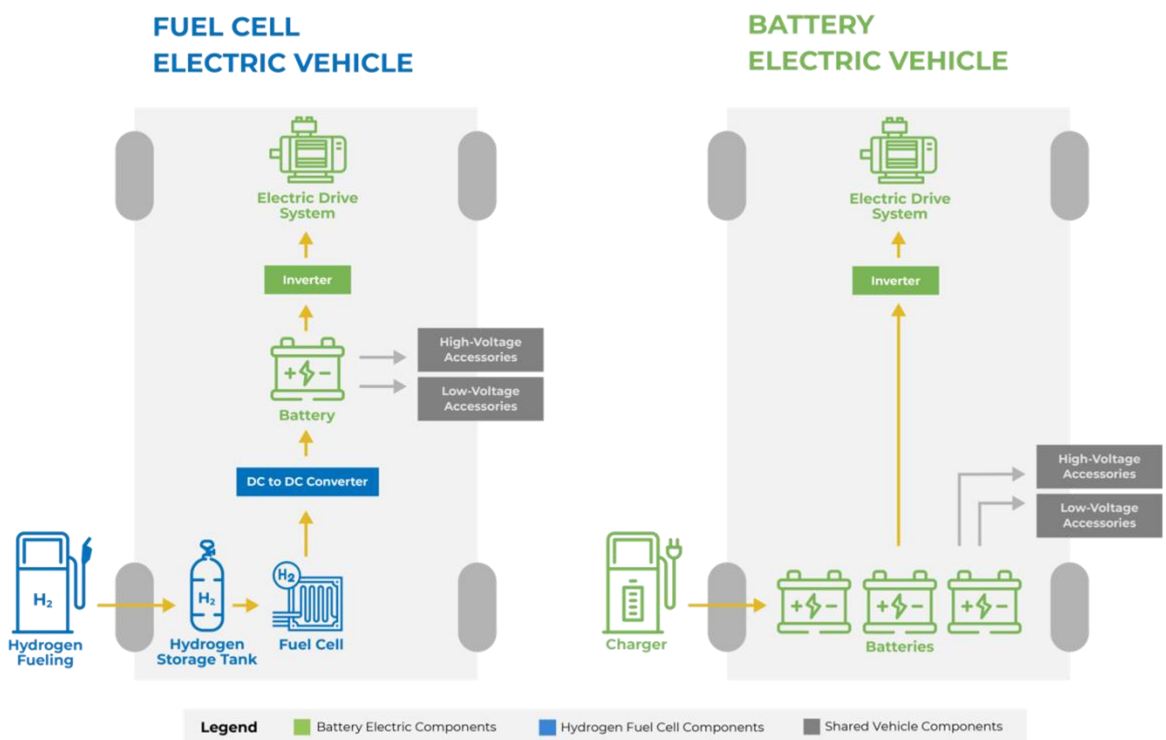

Figure 1 - Battery and Fuel Cell Electric Bus Schematic

A

Transit Agency Information

Culver CityBus Background Information

Culver City is a small, 5-square-mile city with approximately 40,779 residents, located on the Westside of the Los Angeles County. As a regional mobility service provider, it operates the Culver CityBus (CityBus), a municipally owned and operated bus line that integrates with the regional rail network, connecting to five rail stations and three major bus hubs. Serving over 4.6 million passengers annually (pre-pandemic) with just 54 buses, CityBus operates seven fixed-route local bus routes and one bus rapid transit line. It also connects to two major universities in the area. Seven of its eight routes connect with at least one rail station, enhancing regional mobility and accessibility. Los Angeles is one of the few cities in the country that does not have rail access to its major airport, and Culver City is one of only two agencies that provides transportation between LAX and the Westside of Los Angeles County. CityBus is one of the most affordable transit providers in the region, offering fares as low as $1.00.

Being a gateway to the Westside of Los Angeles comes with both advantages and disadvantages. One significant challenge is traffic. Culver City is situated at one of the most congested freeway intersections in the world, where the I-405, the busiest freeway in the U.S., intersects with the I-10 freeway. Furthermore, there are four major east-west arterial roads and two major north-south arterial corridors running through the city. As a result, many drivers pass through Culver City to avoid the congested freeways. On the positive side, Culver City is growing by leaps and bounds, emerging as one of the fastest-growing digital media hubs in Southern California. Major companies such as Amazon Prime, Apple TV+, HBO, TikTok and other firms have expanded into the area, attracted by its central location and rich film industry heritage.

Culver City has taken on the challenge of traffic by becoming a regional mobility service provider, guided by its mobility vision: rethinking mobility, connecting community and enhancing quality of life. As one of the region's most affordable transit providers, the city recognizes its responsibility to connect residents, businesses, and visitors as they move to, through, and from Culver City.

Culver CityBus' service area encompasses Culver City and the Los Angeles communities of Century City, Marina del Rey, Mar Vista, Palms, Playa Vista, Rancho Park, Venice, West Los Angeles, Westchester and Westwood. Service runs from the University of California at Los Angeles (UCLA) to the north, to the Metro Green Line Station to the south, and from Fairfax Avenue to the east, to Venice Beach to the west. Culver CityBus' service area encompasses approximately 33 square miles. The population of this area is approximately 530,000.

Culver City collaborated with the Center for Transportation and the Environment (CTE), AECOM, Sage Energy Consulting (Sage), New Flyer, and Southern California Edison (SCE) to develop a Zero-Emission Bus Transition Plan, aiming for full fleet transition to zero-emission by 2040. In 2021, Culver City initiated the first phase of this project by purchasing and deploying four Battery-Electric Buses (BEBs) along with temporary chargers as part of a pilot program. For the next ZEB deployment, Culver City will purchase and deploy 2 more FCEBs in 2025 and plan to transition all buses in the fleet to zero-emission electric technologies.

For over two decades, Culver City has been a leader in sustainable fleet operations, relying heavily on alternative fuels to power the City's fleet. In 2004, the Culver CityBus transit fleet became the first in the South Coast Air Quality Management District, and the second in California, to transition entirely compressed Natural Gas (CNG). This commitment not only reduced pollutants within the City limits and within its transit service area on the Westside of the Los Angeles County, the City's efforts to incorporate advanced fuel technologies into its operations have been replicated throughout the United States. The City is now working toward the evolution to zero emission.

About CityBus

Transit Agency's Name: Culver CityBus

Mailing Address: The City of Culver City
4343 Duquesne Avenue
Culver City, CA 90232

Transit Agency's Air Districts: South Coast Air Quality Management District

Transit Agency's Air Basin: South Coast

Total number of buses in Annual Maximum Service: Annual maximum of 44 buses operating simultaneously in a fleet of 54 buses

Population of Urbanized Area: 40,779 (2020 Census)

Contact information of general manager, chief operating officer, or equivalent:

Diana Chang
Chief Transportation Officer
4343 Duquesne Avenue
Culver City, CA 90232

Is your transit agency part of a Joint Group? No

CityBus' Zero-Emission Bus Mission

Widespread adoption of zero-emission bus technology has the potential to significantly reduce greenhouse gas (GHG) emissions from the transportation sector. Culver City is committed to implementing environmentally-friendly policies and reducing its carbon footprint, with a goal of electrifying the entire CityBus fleet by 2040. In pursuit of this goal, the City has collaborated with the State of California to use the statewide Department of General Services (DGS) contract to execute a purchase order with New Flyer of America for the purchase of 4 battery electric buses and associated charging infrastructure ahead of the ICT Regulation requirements. These first four BEBs were delivered in Fall 2021. CityBus plans to expand service to a total of 166 buses, comprising both BEBs and FCEBs.

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 100% zero-emission fleets by 2040. The ruling specifies the percentage of new bus procurements that must be zero-emission buses for each year of the transition period (2026 – 2040). Those annual percentages for Small Transit agencies are outlined below:

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 schedule lays out a pathway to reaching 100% zero-emission fleets in 2040 based on a 12-year projected lifespan for a transit bus. Agencies have the opportunity to request waivers, however, that allow purchase deferrals in the event of economic hardship or if zero-emission technology has not matured enough to 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.

CityBus' fleet transition strategy is to replace each ICE bus with a ZEB as they reach the end of their useful life at the end of 12 years of service, which avoids the early retirement of ICE buses. **Figure 3** shows the number of each bus type that are purchased each year through 2040 with this replacement strategy.

CityBus's Rollout Plan General Information

CityBus's Rollout Plan lays out a pathway to achieve a zero-emission fleet by 2040, on-schedule with the 2040 mandate. To achieve this goal, CityBus will replace all ICE buses with ZEBs when they reach the end of their 12-year useful life, beginning in 2029.

Rollout Plan's Council Approval Date: September 23, 2024

Resolution No. (optional): TBD

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

Contact for Rollout Plan follow-up questions: Questions can be directed to Diana Chang, whose contact information can be found in Section A.

Who created the Rollout Plan? This Rollout Plan was created by Culver CityBus with assistance from the Center for Transportation and the Environment.

Rollout Plan as a Living Document

CityBus created this ICT Rollout Plan in combination with its Zero-Emission Bus Transition Master Plan, which lays out CityBus's plans for transition in greater detail. The Master Plan will be maintained and updated on an annual basis. This ICT Rollout Plan document describes CityBus's plans for reaching a zero-emission fleet. It is intended to be a living document to guide the implementation of zero-emission bus fleets through potential deployment challenges. The Rollout Plan provides only estimated timelines based on current information for bus purchases, infrastructure upgrades, workforce training, and other developments and expenses. CityBus may update the Rollout Plan as needed as the industry continues to develop and as the Master Plan is updated.

C

Technology Portfolio

Zero-Emission Bus Technology Selection

ZEB Transition Planning Methodology

This ICT Rollout Plan was created in combination with CityBus's ZEB Transition Master Plan, utilizing CTE's ZEB Transition Planning Methodology, which is a complete set of analyses used to inform agencies converting their fleets to zero-emission technology. The methodology consists of data collection and analysis and assessment stages. These stages are sequential and build upon findings in previous steps. The work steps specific to this study are outlined below:

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

For the purposes of this document, the Requirements & Data Collection, Service Assessment, Fleet Assessment and Facilities Assessment are of particular importance since they provide the majority of the information requested by CARB. These stages are outlined below:

For the **Requirements Analysis & Data Collection**, CTE collects data on the agency's fleet, routes and blocks, operational data such as mileage and fuel consumption, and maintenance costs. Using this data, CTE establishes requirements for the planned zero-emission fleet to drive analyses in the later assessments.

The **Service Assessment** phase initiates the technical analysis of the study. Using information collected in the Data Collection phase, CTE evaluates the feasibility of a zero-emission fleet over the study timeframe. Results from the Service Assessment are used to guide ZEB procurements in the Fleet Assessment and to determine energy requirements in the Fuel Assessment.

The **Fleet Assessment** develops a projected timeline for replacement of current buses with ZEBs that is consistent with the agency's fleet replacement plan. This assessment also includes a projection of fleet capital cost over the transition timeframe and is optimized with regard to state mandates, like CARB's ICT regulation, or agency goals, such as minimizing cost or maximizing service levels.

The **Facilities Assessment** determines the necessary infrastructure to support the projected zero-emission fleet based on results from the Fleet Assessment and Fuel Assessment. This assessment provides quantities of charging infrastructure and calculates associated costs sequenced over the transition timeframe.

Requirements Analysis & Data Collection

The Requirements Analysis and Data Collection stage begins by compiling operational data from CityBus 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 CityBus' routes by determining their average speed and grades, and classified them as fast or slow and flat or hilly. CTE used these classifications to model the energy efficiencies for each of CityBus' routes. The calculated efficiencies were then used in the Service Assessment to determine the energy requirements of CityBus' service.

CTE evaluated BEBs and FCEBs to support CityBus' technology selection. After collecting route and operational data, CTE determined that CityBus' longest block is just over 200 miles long. Based on observed performance, CTE estimates FCEBs can complete any block under 350 total miles, which means that FCEB technology already has the capability to meet service requirements. Although FCEBs were determined to have the capability of serving all of CityBus' routes, CityBus was interested in exploring a BEB and FCEB service scenario, so it was necessary to determine how much of CityBus's service could feasibly be served by depot-only charged BEBs in order to develop a ZEB transition scenario that would be suitable to the agency's service.

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's bus operational behavior, and vehicle 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 CityBus to determine efficiency and range estimates based on an accurate representation of its operating conditions.

To understand BEB performance on CityBus routes, CTE modeled the impact of variations in passenger load, accessory load, and battery degradation on 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). System-wide energy use is estimated in subsequent assessments.

Service Assessment

Service Assessment Methodology Overview

Given the conclusion that FCEBs could meet the range requirements for CityBus' service, the Service Assessment focused on evaluating the feasibility of BEBs in CityBus' service area. In this stage, the efficiencies that were modeled in the Requirements Analysis & Data Collection stage are used to estimate the energy requirements of CityBus' service.

The main focus of the Service Assessment is 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"[1] and is usually comprised of several trips on various routes. The energy needed to complete a block is compared to the available energy of the respective bus to service the block. If the bus's usable onboard energy exceeds the energy required by the block, then the conclusion is that the battery electric bus can successfully operate on that block.

The results from the analysis are used to determine when, or if, each block could transition to being served by BEBs and can be used to inform BEB procurements in the Fleet Assessment. Results from this analysis are also used to determine the specific energy requirements for the agency.

Assumptions

CTE met with CityBus to define assumptions and requirements used throughout the study. The following assumptions were developed based on CTE and CityBus' efforts:

- The Service Assessment applies assumptions to battery electric technology improvement over time. The analysis assumes a 5% improvement in battery capacity every other year and a starting battery capacity of 660 kWh.
- This analysis also assumes blocks will maintain a similar distribution of distance, relative speeds, and elevation changes that existed at CityBus pre-COVID 19 since bus service will continue to serve similar locations within the service area and use similar roads to reach these destinations even if specific routes and schedules change.
- Fleet composition remains constant. This means that no buses are assumed to be added to accommodate range restrictions, although some will be added to meet projected service increases, and that buses will be replaced with buses of the same length.
- Buses are assumed to operate for a 12-year service life.
- Usable on-board energy is assumed to be that of a mid-life battery 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 it was assumed that the top and bottom portions of the battery are unusable.

[1] 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

Results

The Service Assessment results in an assessment of which CityBus blocks can be serviced by current battery technology with depot charging only and also determines a timeline for when zero-emission bus technology becomes capable of achieving the remaining blocks as technology improves. The results from the Service Assessment are used to guide ZEB procurement projections in the Fleet Assessment.

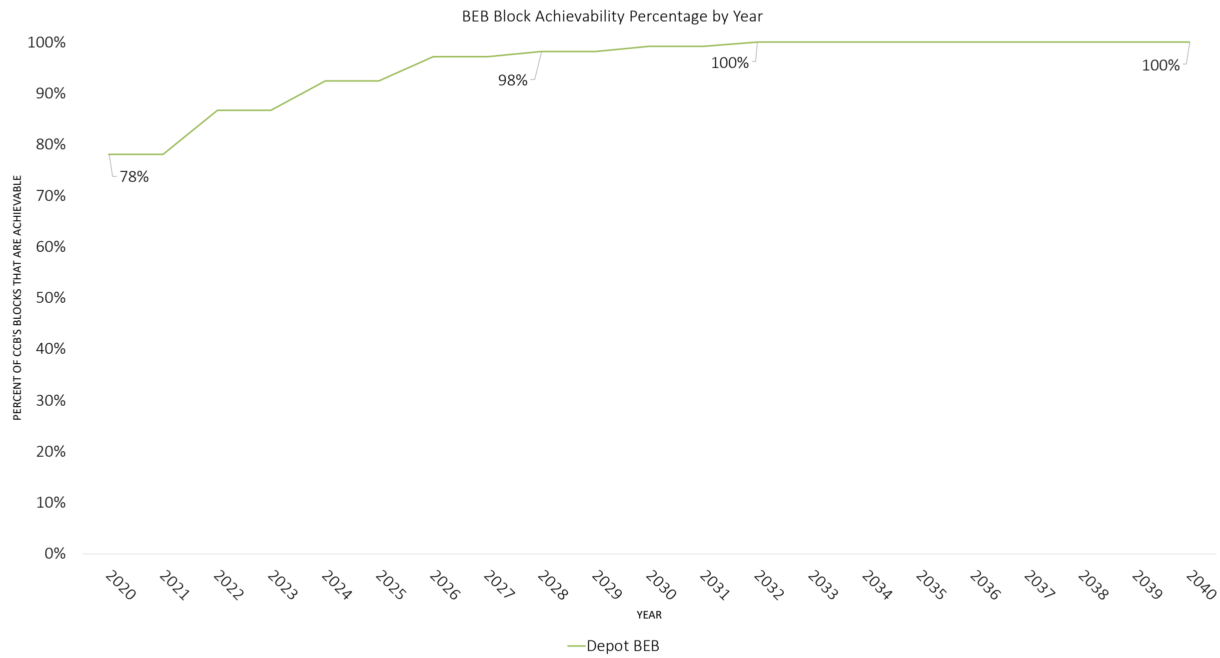

Figure 2 – BEB Block Achievability Percentage by Year

Figure 2 – BEB Block Achievability Percentage by Year shows that all CityBus blocks can be completed by depot-only charged BEBs by 2032. CityBus recognizes that there are more operational challenges with BEBs beyond just range, such as the time required to charge, the space requirements of charging equipment for BEBs, and the risk of relying on a single fuel type, which led the agency to decide to pursue a mixed fleet. Adding FCEBs will also ensure that the agency's vehicles will have sufficient range to meet service requirements even if the City were to add commuter routes to outside of the LA area.

Why a Mixed Fleet?

Based on the analysis of CityBus's operational data and the stated assumptions, CTE concludes that Culver City's service could be entirely served by depot charged BEBs or FCEBs. Since both technologies are well suited to this service, Culver City's technology decision was not driven by range, but rather by operational considerations and resilience. Although BEB technology and electricity are currently less expensive than FCEBs and hydrogen, Culver City sees operational advantages to FCEBs' fueling time, which is comparable to ICE technologies, and to the space requirements for a hydrogen fueling station which are easier to accommodate than numerous chargers in the yard. Culver City also sees risk in being entirely reliant on a single fuel type since if either fuel supply was ever interrupted, it would result in the agency not being able to meet service requirements.

Resilience was also the determining factor for the fleet split. The agency plans to convert their current depot to an entirely BEB depot. This technology shift will mean that the depot loses several parking spaces to accommodate chargers, which means that after transitioning, the yard will only be able to accommodate 45 BEBs. Culver City plans to also accommodate 45 BEBs at the new depot so that if one depot were to ever lose power, the buses may still be able to charge at the other depot. The remainder of the fleet at the new depot will be the FCEB portion of the fleet. The fleet procurement plan and associated costs will be discussed further in Section D below, where the Fleet Assessment is outlined.

D

Current Bus Fleet Composition and Future Bus Purchases

Fleet Assessment Methodology

The Fleet Assessment develops a projected timeline for the replacement of existing buses with ZEBs that is consistent with CityBus's fleet replacement plan based on the 12-year service life of transit buses. This assessment also includes a projection of fleet capital costs over the transition timeline.

ZEB Cost Assumptions

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

- BEB and FCEB purchase costs are based on the State of California statewide procurement contract base bus price for 40-foot BEBs and FCEBs executed in 2019 with Producer Price Index (PPI) rates used to adjust to current pricing (PPI rate for WPU141301 - Truck and Bus Bodies Sold Separately).
- Bus costs are inclusive of estimates for configurable options and taxes.
- The battery capacity for BEBs will continue to increase, which will result in improved range, but the cost for batteries will not increase or decrease.
- Costs for retrofits or bus conversions are not included because CityBus does not plan to convert any CNG buses to battery electric powertrains.

Table 2 provides estimated bus costs used in the analysis.

Table 2 – Fleet Assessment Cost Assumptions

	Battery Electric Cutaways	Fuel Cell Electric Cutaways	40' BEB Pricing	40' FCEB Pricing
Vehicle Cost	$296,804	$370,965	$1,160,000	$1,309,000
Extended Battery Warranty			$75,000	
Inflation (PPI Commodity Data - WPU141301)	*1.50%*	*1.50%*	*1.50%*	*1.50%*
Total	**$296,804**	**$370,965**	**$1,235,000**	**$1,309,000**

Note: 40'bus costs based on 2019 California State Contract escalated to 2021 pricing, inclusive of options, extended battery warranty, tax and inflation as shown. Battery electric cutaway pricing based on NM state contract pricing. Fuel cell cutaway pricing is projected from battery electric cutaway pricing escalated based on cost ratio between 40' BEBs and 40' FCEBs.

Mid-Life Expenses

As seen in **Table 2** above, CityBus plans on purchasing extended battery warranties on all of their BEBs to cover battery replacements. Battery replacements occur after approximately six years of bus service. FCEBs will similarly incur a midlife fuel cell refurbishment, but this cost is not included in the vehicle purchase price.

Description of CityBus's Current Fleet

Understanding Culver City's current service is necessary to evaluate the costs of a full zero-emission transition. Culver City staff provided the following key data on current service to be used as inputs to the analysis:

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

Fleet

Culver City's active fleet is comprised of 50 standard 40-foot New Flyer Renewable Compressed Natural Gas (RCNG), 4 Battery Electric buses, and 3 CNG Cutaways. The agency also maintains a reserve of CNG buses of varying ages. This reserve is expected to grow temporarily between now and 2028, when the city will host the Summer Olympics and ridership is anticipated to increase drastically. Following 2028, reserve buses will be replaced with ZEBs in the active fleet to permanently expand the fleet to meet gradual, permanent service demand increases. Buses currently in the fleet range in age from model year 2001 to 2021; the average age is 10 years. CityBus has decided on mixed BEB and FCEB fleet transition with procurement through 2040.

All buses are currently housed at a single depot, located at 4343 Duquesne Avenue, Culver City, CA. In anticipation of the previously mentioned increased demand, Culver City plans to expand their permanent fleet from 54 buses and 3 cutaways to 160 buses and 6 cutaways by 2040. Even if the fleet size was not anticipated to increase, Culver City's current depot is too small to accommodate its ZEB transition due to the space required for the ZEB fueling infrastructure and the agency will need to expand to a second depot. This new depot's location is yet to be determined.

Routes and Blocks

Culver City's service consists entirely of fixed routes, operating eight routes centered in downtown Culver City and serving the Westside of the Los Angeles County. Routes 1 through 7 operate as local weekday and weekend service. In addition, Route 6 runs as a separately-branded rapid service on weekdays. Culver City's service is organized into 105 unique blocks comprised by these eight routes. Blocks range in mileage from 7 miles to just over 200 miles and take from about 1 hour to 18 hours of service time. There are 68 weekday blocks, 20 Saturday blocks, and 17 Sunday blocks. Buses pull out from the depot as early as 4:45 a.m. and can return after midnight. CityBus' ZEB Transition Plan assumes that the amount of service hours will remain the same per bus, so as the fleet expands, the amount of service will increase proportionally.

Current Mileage and Fuel Consumption

Culver City operates a RCNG and BEB fleet

Annual mileage of the fleet (54 buses): 1.7 million miles

Annual fuel consumption: Approximately 1 million gasoline-gallons-equivalent (GGE) of RCNG

Fleet average efficiency: 3.1 mpg

CityBus current fuel expense: $985k in 2023

Average RCNG cost: $2.31 per GGE ($0.75 per mile)

CityBus' ZEB Transition Plan assumes that the amount of service miles will remain the same.

Zero-Emission Bus Procurement Plan and Schedule

As determined in the Service Assessment and discussed in the Technology Portfolio, the agency is interested in pursuing a mixed fleet for preferable operating conditions and resilience. The fleet transition strategy is to replace each RCNG bus with a ZEB as they reach the end of their 12-year useful life. No buses will be retired prior to the end of their useful life. Purchases to expand the total fleet count will also occur in the years between replacement purchases to keep annual fleet procurement numbers reasonable for the agency. **Figure 3** provides the number of each bus type that is purchased each year through 2040 with this replacement strategy.

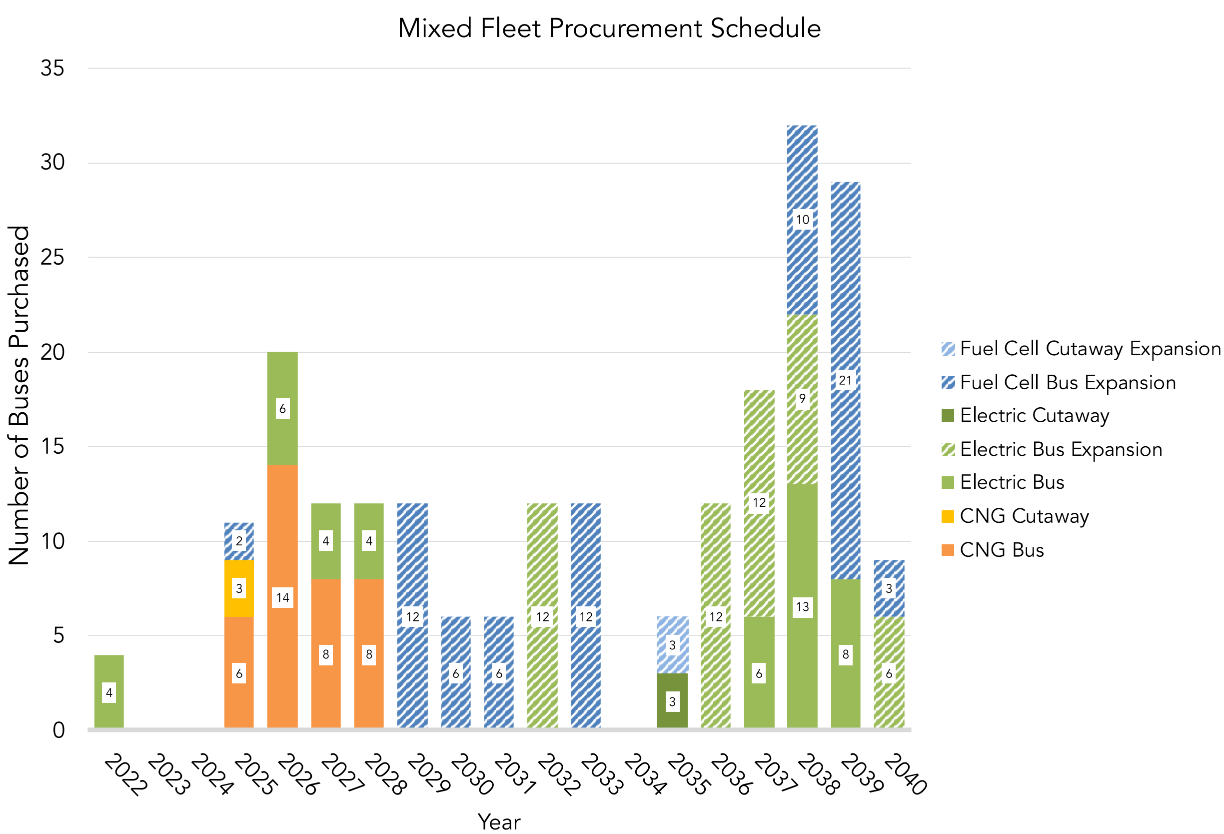

Figure 3 – Projected Bus Purchases

Figure 4 depicts the annual composition of the CityBus fleet through 2040. By 2040, CityBus' fleet consists entirely of zero-emission buses that are fueled at the depots. The fleet increases from 57 buses in 2022 to 166 buses in 2040 as shown in **Figure 4**. The second facility is expected to be operational by 2029 to coincide with the addition of 12 FCEBs to the fleet in that year.

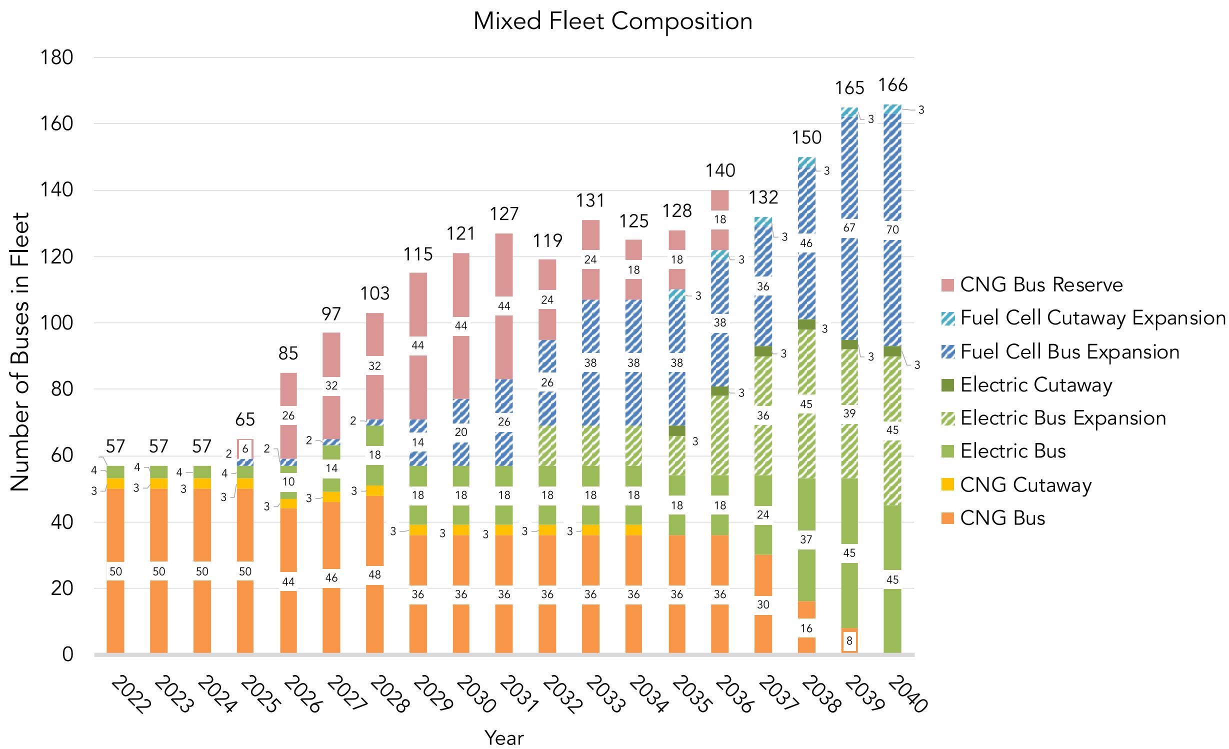

Figure 4 - Annual Fleet Composition

Projected Annual Capital Costs for ZEB Purchases

Figure 5 shows the annual capital costs for all ZEBs purchased in a given year through 2040. The expected total capital cost over the entire transition period is around $321 million, compared to the $171 million that would have been incurred by continuing to purchase RCNG replacement buses over that period. As noted in **Table 2 –** Fleet Assessment Cost Assumptions, these cost estimates include a PPI escalation rate of 1.5% per year and an extended battery warranty that will cover the cost of a mid-life battery replacement. Costs are incurred cyclically, according to the 12-year replacement cycle of transit buses. CityBus will replace the last RCNG bus with zero-emission buses in 2040 and will thus incur costs of converting to a fully ZEB fleet from 2020 until end of 2040 and those RCNG buses are scheduled to be replaced from 2026 to 2040 as they reach the end of their useful lives.

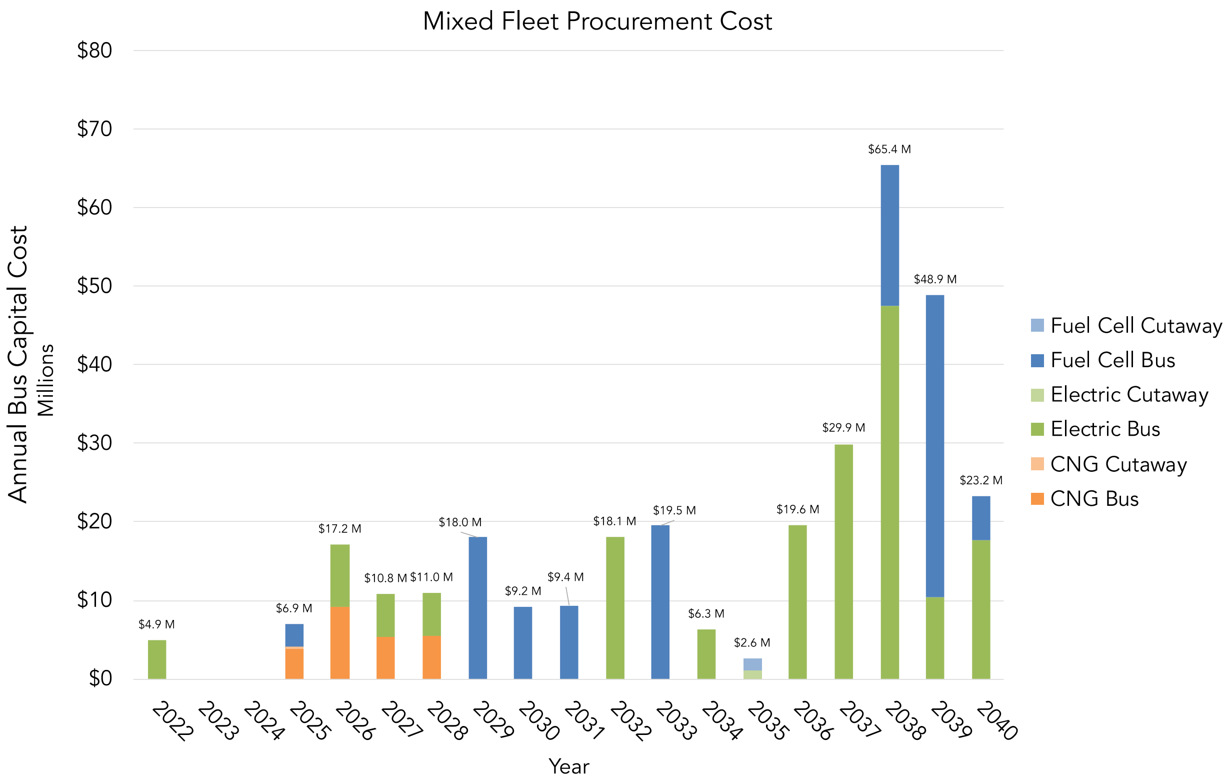

Figure 5 - Annual Capital Costs

Procurement Costs

As seen in **Table 3** the capital investment in purchasing ZEBs is significantly higher than for RCNG buses. This highlights the importance of staying vigilant in the search for funding opportunities to help fill this gap. The ICE Baseline is an estimate of how much the agency would have expended through 2040 on bus capital costs without transitioning. The ZEB incremental cost is the difference between the ICE Baseline costs and the projected cost of transitioning. The ZEB Transition Scenario Cost is the total bus capital cost expected in transitioning.

Table 3 – CityBus Bus Capital Investment to transition to a 100% ZEB fleet by 2040

Incremental cost of ZEB Transition (2021-2040)		
ICE Baseline	ZEB Incremental Costs	ZEB Transition Scenario Costs
$171M	$150M	$321M

Fuel Costs

Culver City's Fuel Assessment includes operation and maintenance costs for fueling infrastructure for BEBs and FCEBs. Fuel cost estimates are based on the assumptions shown in **Table 4** and **Table 5** below. Fueling infrastructure maintenance costs are included in the fuel price for all fuel types. EIA fuel inflation rates are applied year over year.

Table 4 - Fuel Cost Assumptions

Fuel Type	Cost per unit	Notes
RCNG	$2.31/GGE	Culver City's reported price (2022)
H2	$8.68/kg	Average of contracted hydrogen delivery pricing reported by agencies

Table 5 - Electricity Cost Assumptions

	Summer Energy	Winter Energy
On Peak	0.55425	
Mid Peak	0.28272	0.32667
Off Peak	0.16046	0.16761
Super Off Peak		0.09856
Demand	To be Phased In	

Electricity costs are based on SCE's TOU-EV-9 Rate Schedule for delivery and CPA's TOU-EV-SUB-9 Rate Schedule for generation. Demand costs are not currently incorporated in SCE's TOU-EV-9 rate, however, SCE plans to add them at some point in the future. CTE estimates future demand costs by phasing in the demand charges from SCE's TOU-8 Rate Schedule over the course of 4 years starting in 2024.

Figure 6 depicts energy consumption for each fuel type over the transition period.

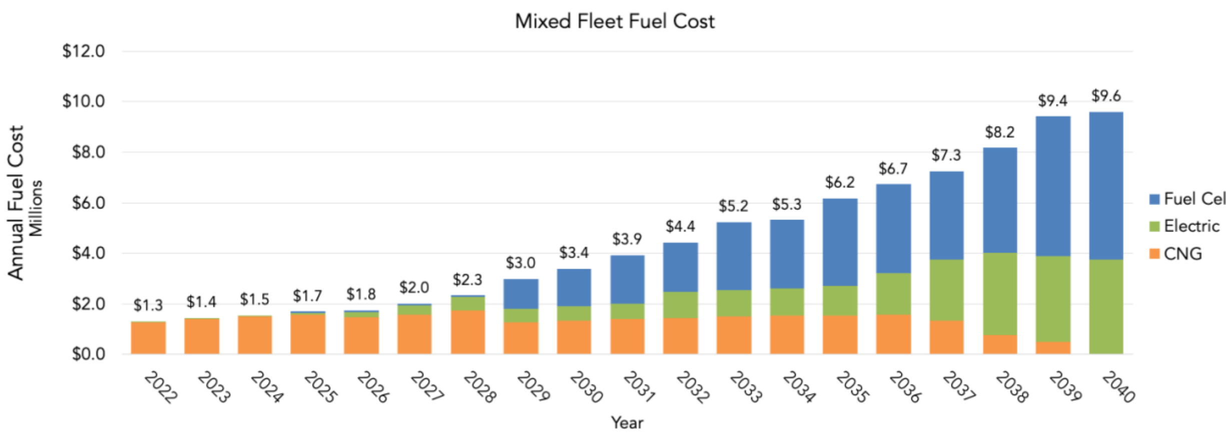

Figure 6 - Mixed Fleet Fuel Cost

Maintenance Costs

Annually, Culver City spends approximately $1.7 million on scheduled and unscheduled maintenance, including both parts and labor, for its entire fleet. This results in an average maintenance cost of $0.94 per mile. Buses also undergo one engine overhaul and one transmission overhaul during their lifetime at an average cost of $10,700 and $7,500, respectively. **Table 6** shows the assumed costs of scheduled and unscheduled labor and maintenance used in this analysis.

Table 6 - Maintenance Cost Assumptions- Parts & Labor

Vehicle Type	RCNG Cutaway	40' RCNG	40' RCNG Reserve	Battery Electric Cutaway	40' BEB	Fuel Cell Cutaway	40' FCEB
Total (per mi)	$ 0.87	$1.64	$1.12	$ 0.54	$ 1.02	$ 0.59	$ 1.12

ZEB Maintenance Cost Assumptions:

- CNG Cutaway midlife overhaul: $10,000, per mile maintenance are based on value reported by agency
- CNG 40' midlife overhaul: $50,000, per mile maintenance are values calculated from Monthly Data Collection form for KPI reports
- Fuel Cell Electric Cutaway extended battery warranty: $10,000 (incl. in purchase price), per mile maintenance costs proportionally adjusted from projected 40' FCEB and 40' BEB costs
- Battery Electric Cutaway: per mile maintenance costs proportionally adjusted from projected 40' FCEB and 40' BEB costs
- BEB 40' extended battery warranties: $75,000 (incl. in purchase price), per mile maintenance values extrapolated from external agency reports, normalized to Culver City's labor rate of $128.38/hour
- FCEB 40' extended battery warranties: $17,000 (incl. in purchase price), midlife overhaul: $40,000, per mile maintenance costs extrapolated from external agency reports, normalized to Culver City's labor rate of $128.38/hour
- Reserve CNG vehicles were assumed to travel 10,000 miles annually to ensure they stay in working order

Table 7 shows the combined labor, materials, and midlife overhaul costs for each year of the transition.

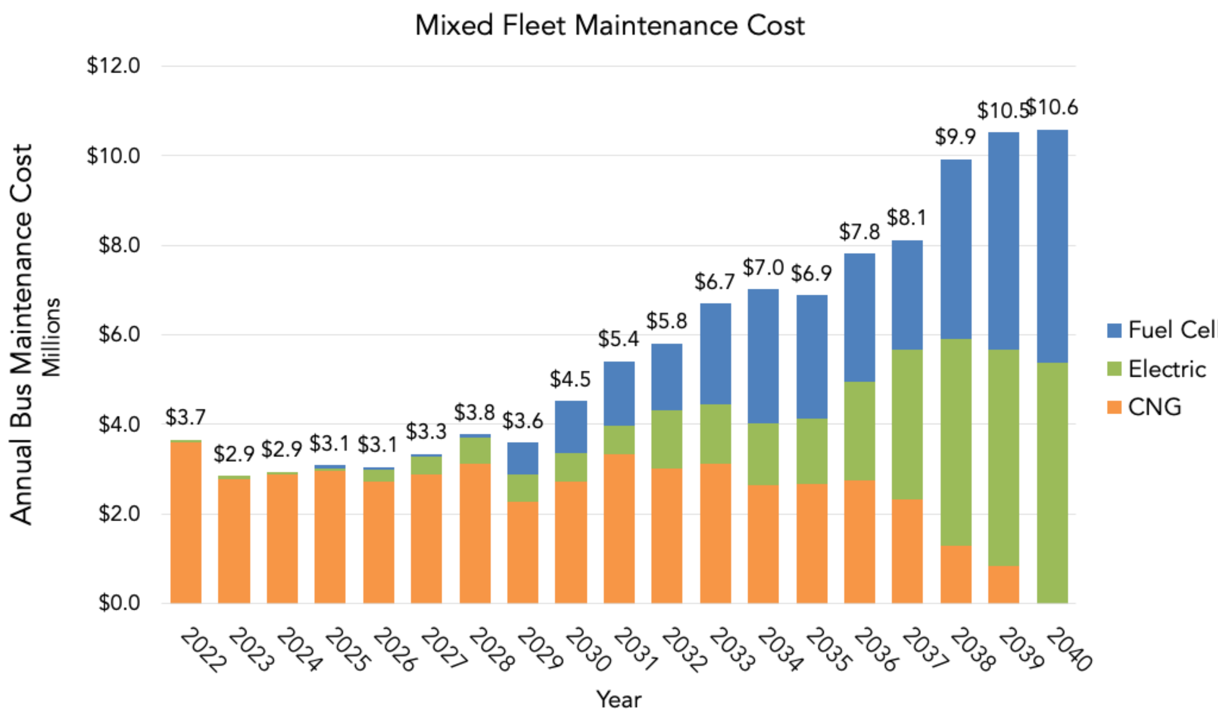

Figure 7 – Mixed Fleet Maintenance Cost

E

Facilities and Infrastructure Modifications

CityBus Current Yard Description

Depot Address: 4343 Duquesne Avenue, Culver City, CA

Electric Utility(s): Southern California Edison (SCE)

Located in a NOx Exempt Area? No

Bus Parking Capacity: 54 buses

Current Vehicle Types Supported: 40-foot standard compressed natural gas buses and 40’ BEBs

Propulsion Types That Will be Supported at Completion of ZEB Transition: 40-foot standard battery electric buses

Facilities Assessment Methodology

Scaling to a fleetwide ZEB deployment requires substantial infrastructure upgrades and a different approach to charging and fueling compared to smaller pilot deployments. With pilot deployments, charging and fueling requirements are easier to meet with plug-in pedestal chargers, mobile hydrogen refueling stations, and minimal infrastructure investment.

Commercial ZEB deployments, however, require installation of charging stations, permanent hydrogen fueling facilities, and improvements to existing electrical infrastructure. These improvements may include upgrades to switchgear or utility service connections. Planning and design work, including development of detailed electrical and construction drawings required for permitting, is also necessary once specific equipment has been selected.

Table 7 and **Table 8** list the cost assumptions for Culver City’s infrastructure projects.

Table 7 – Facilities Cost Assumptions- Charger and Installation Costs

	Cost	Unit
A&E Design Planning	$200,000	per depot/parking location
Initial Duct/Bank	$ 300,000	per depot/parking location
Incremental Duct Bank/Conduit	$ 300	per Lineal Foot
Spaceframe/Island/Charger Pads	$ 2.7M	Total
A&E Design Planning	$200,000	per project
Charger + Installation	$110,000	Per 150 kW Charger

Key assumptions applied in CityBus' Facilities Assessment are as follows:

- One plug-in reel per bus;
- Two buses per 150 kW charger;
- Two charge windows, i.e., no more than half the buses charge at any given moment;
- Off-peak, overnight charging with automated charge management software; and
- Dispenser capacity to serve up to 80% of the fleet at a time; no movement of buses overnight.

Table 8 – Facilities Cost Assumptions- Hydrogen Fueling Facility Options

	Cost	Unit
Mobile Fueler Lease	$72,000	Per year for years when fleet is fewer than 10 FCEBs
15,000-gal Tank	$4,200,000	Per large tank and associated H2 storage infrastructure (75+ bus capacity with up to daily delivery)
Fueling lane	$380,000	Per lane, including one dispenser and associated fueling equipment (pad, pre-chiller, etc). A total of two lanes was assumed
Maintenance Bay Upgrades from CNG	$13,600	per bay

Infrastructure: Cost Summary

Figure 8 shows the projected costs of BEB and FCEB infrastructure in the year the costs are incurred. The estimated total infrastructure costs are approximately $21 million for the infrastructure installed at both depots. This total cost includes all gantry projects (including the duct, bank, and charger pad costs required to support the installed chargers along with the gantry), all power upgrade projects, all charger and dispenser installations, hydrogen station build projects, all planning projects, design engineering costs, the added 20% contingency on all costs, design planning project, hydrogen facility build, and 1.5% annual inflation.

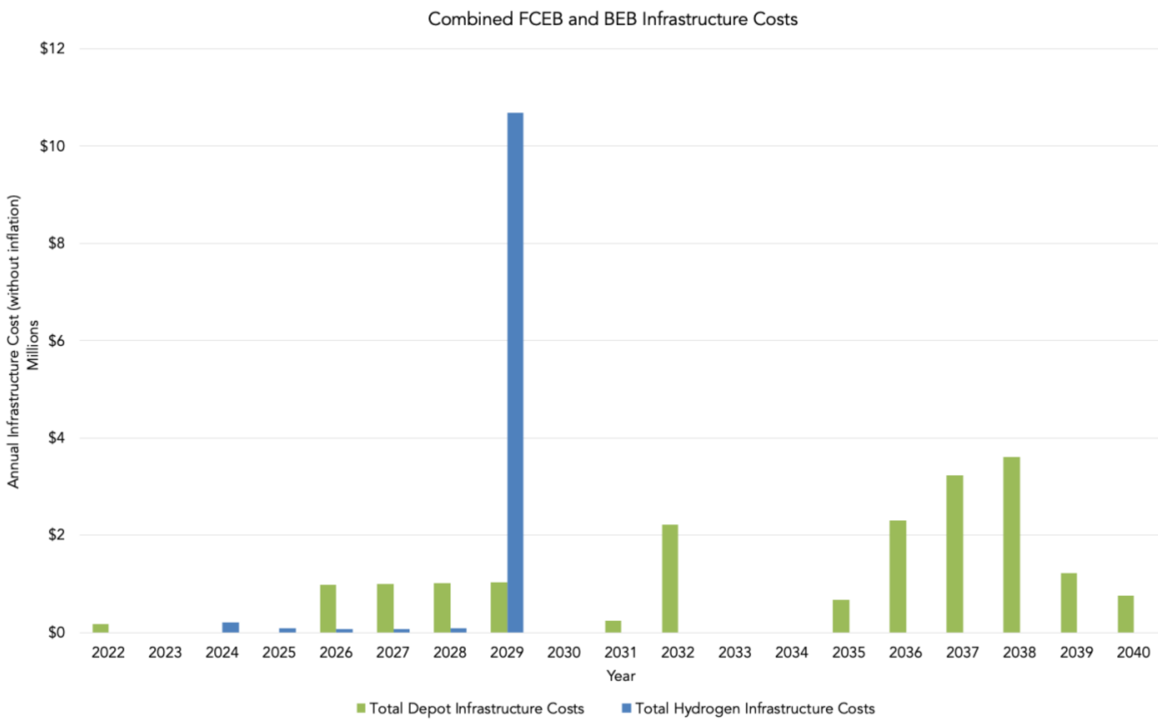

Figure 8 - BEB and FCEB Infrastructure Costs

Table 9 - CityBus Infrastructure Capital Investment to transition to a 100% ZEB fleet by 2040

	RCNG Baseline	Total Mixed Fleet Infrastructure Costs
Fueling Infrastructure	$0	$29,699,000*

*Does not include SCE Charge Ready contribution

Looking at **Table 9** - CityBus Infrastructure Capital Investment to transition to a 100% ZEB fleet by 2040, the infrastructure required for this transition to a fully zero-emission fleet has a significant expense that would not be incurred by maintaining a RCNG fleet. There is, however, funding available to help fill this gap, and CityBus should be able to meet the financial need through additional grant funding.

Description of Changes to Parking Requirements

CityBus's current yard can only accommodate 47 buses in marked parking spaces. To support the zero-emission transition, which require set parking spaces with the appropriate infrastructure, CityBus will need to expand to a second facility. The location for this new facility will be determined in the future. The new facility will also support the additional buses that CityBus plans to procure as part of its fleet expansion to meet anticipated future demand for transit service. Construction of a new facility is anticipated to take between 5-8 years, from securing funding to completing construction. This process will involve significant investment in property acquisition, design, and construction. Given that the new facility is necessary before CityBus can fully transition to zero emission, CityBus will need to replace some CNG buses with CNG buses initially. These replacements will be prior to 2029 and will comply with the ICT ZEB percentage requirements of the ICT Regulation. This will allow time to build the new facility and the required infrastructure for the zero-emission transition.

F

Providing Service in Disadvantaged Communities

Providing 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. Los Angeles County includes many disadvantaged communities, several of which are located within the Culver CityBus service area. Line 4, Line 6 and the Rapid 6 all pass through DACs. CityBus' earliest ZEBs deployments will target these routes, and all of these routes will be fully electrified by 2040.

Culver CityBus serves a predominantly low-income population that relies heavily on public transit services. Sixty-three percent of riders have an annual household income of less than $25,000. The map in Figure 8 shows the distribution of disadvantaged communities in Culver CityBus' service area. Culver CityBus has direct transit services to low-income and disadvantaged communities near Slauson Ave and the I-405 Freeway as well as to the Mar Vista Gardens public housing facility. Culver CityBus connects DACs to work and healthcare opportunities both within Culver City and beyond through connections with wider bus and rail transit systems.

Environmental impacts, both from climate change and from local emissions, disproportionately affect transit riders. For instance, poor air quality from tailpipe emissions and extreme heat harm riders waiting for buses at roadside stops. These impacts are environmental justice issues because disadvantaged communities are more likely to suffer poor air quality due to their proximity to freeways and other emissions sources.

The transition to an electric fleet will improve air quality and support better public health outcomes for residents in DACs served by the selected routes because DACs are presently at greater risk of harm from air pollution. The transition to zero-emission technology will benefit the region by reducing fine particulate pollution and improving overall air quality, thus leading to enhanced quality of life in the DACs mentioned above.

Public transit has the potential to greatly improve social equity by providing mobility options to low-income residents without access to a personal vehicle, helping to meet their daily needs. Owning a car is not cheap, and many people rely solely on public transportation for their mobility needs. Access to quality transportation is arguably one of the greatest single factors of upward socioeconomic mobility, as it provides residents with the means of getting around 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, Culver City is able to improve service reliability and therefore has a better capacity to serve low-income populations that reside in DACs.

Census Tracts in Service Area Identified as DACs

CityBus Provides service through the following Census Tracts identified as SB 535 Disadvantaged Communities:

6037220100
6037219902
6037980028
6037277200
6037277400
6037601401

Map of CityBus Service in DACs

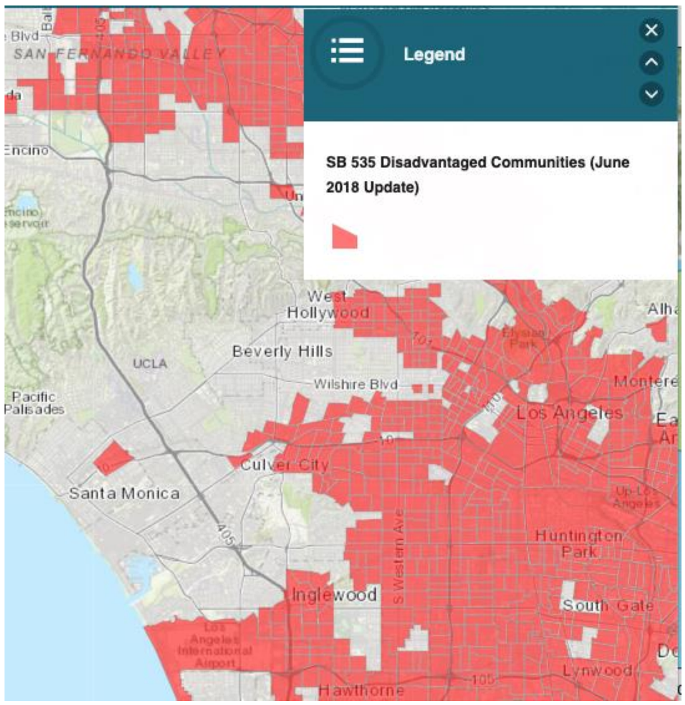

Figure 9 – Map of DAC's in CityBus Service Area

Zero-Emission Service for DACs

Emissions Reductions for DACs

To understand the impacts of transitioning to an electric fleet, emissions calculations were conducted for both fuel types that can be categorized into two groups: tailpipe greenhouse gases and fuel production greenhouse gases.

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

Criteria pollutants include carbon monoxide (CO), nitrogen oxides (NO_x), 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. These compounds are also commonly responsible for acid rain and smog. Their relative economic, environmental and health effects are felt locally to where they are produced.

By transitioning to ZEBs from RCNG buses, CityBus's fleet will produce less carbon emissions and harmful pollutants at the vehicle tailpipe. By operating BEBs using 100% renewable electricity, no upstream GHGs will be produced, and FCEBs using green hydrogen produced with renewable electricity will have much lower upstream GHGs than CNG. Using current estimates for social costs, a monetary cost savings can be applied to these emissions reductions. These costs will not be directly realized by CityBus, but are considered externality costs that are distributed amongst by the global and local population depending on the type of emission.

Disadvantaged communities served by CityBus will therefore benefit greatly from the reduced tailpipe emissions of ZEBs compared to RCNG buses.

All quantities and costs shown were calculated using data from the California Air Resources Board's approved LCFS pathways.

Table 10 – Fleet Transition Emissions Benefits

Emission Type	Emissions Quantity (2020-2040)	Social Cost (2020-2040)
Well to Wheel GHGs	16,720 metric tons	$852,700

G

Workforce Training

CityBus' Current Training Program

CityBus is highly experienced in recruiting, hiring, training, and integrating new staff to ensure that its employees are qualified to provide quality services to riders. Through the introduction of Safety Management System (SMS) into its operating environment, CityBus emphasizes safety promotion programs that help ensure that competencies in training are met. Once hired, staff undergo rigorous training curriculum in SMS to ensure system compliance and understanding of safety roles and responsibilities pertaining to their job duties. Examples of these trainings are as follows:

- Drug & Alcohol Training
- Federal Emergency Management Agency (FEMA) Training
  - National Incident Management System courses 100, 700, & 800
- California Department of General Services defensive driving course
- Classroom & In-Service Training
  - Vehicle familiarization training
    - Battery Electric Bus
    - Fuel Cell Bus
    - Electric Minibus
    - CNG Bus
    - Cutaway Bus
    - General vehicles
  - Vehicle pre-trip & post-trip inspections
  - Mirror & Seat adjustment
  - Safety & Defensive Driving
  - Professional Operator Responsibilities
  - Customer Service Training
  - Americans With Disabilities Act Training (ADA)
  - Emergency & Accident Procedures
  - Hours of Service Training
  - Occupational Safety & Health Administration (OSHA) Training
  - Department & City Policies/Procedures Training
- Behind the Wheel Training
  - VTT Driving
  - Revenue Service Driving
- Preventative Maintenance Training
- Compressed Natural Gas (CNG) System & Fueling Training

- Covid-19 Safety Procedures Training

To support our maintenance team training and professional development, CityBus coordinates training with third party vendors such as the Southern California Regional Transit Training Consortium (SCRTTC). This organization provides instructional courses on how to perform maintenance and repairs to equipment by applying industry standards and best practices. All training courses provide comprehensive instructions on how to safely operate and maintain all components of equipment.

CityBus actively exercises its Safety Management Policy program activities as outlined in their Public Transportation Agency Safety Plan (PTASP). Training is provided to all CityBus employees on an as needed basis, quarterly, and annually. All training activities are done in compliance following the California Code of Regulations Title 13, OSHA regulations, & FTA regulations.

CityBus' ZEB Training Plan

OEM Training

CityBus plans to take advantage of trainings from manufacturers of ZEB equipment, whether it is the bus, management software, charging equipment, or refueling equipment. 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 O&M

The transition to a zero-emission fleet will have significant effects on CityBus' workforce. Meaningful investment is required to train maintenance staff and bus operators who are more familiar with maintenance and fueling infrastructure for internal combustion engine systems.

CityBus training staff will work closely with ZEB manufacturers to ensure all mechanics, service employees, and bus operators complete necessary training prior to deploying ZEB technology and that these employees undergo refresher training annually and as needed. CityBus 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

H

Potential Funding Sources

Sources of Funding for ZEB Transition

CityBus is prepared to pursue funding opportunities at the federal, state, and local level, as necessary and as available.

Federal

CityBus is exploring federal grants through the following funding programs: Federal Transit Administration's (FTA) Urbanized Area Formula program; discretionary grant programs such as the Bus and Bus Facilities (B&BF) program, the Low or No Emission Vehicle Deployment Program (LoNo), and the Better Utilizing Investments to Leverage Development (BUILD) grant; and other available federal discretionary grant programs. See below for a list of federal-level funding opportunities identified by CityBus:

- United States Department of Transportation (USDOT)
  - Better Utilizing Investments to Leverage Development (BUILD) Grants
- Federal Transportation Administration (FTA)
  - Capital Investment Grants – New Starts
  - Capital Investment Grants – Small Starts
  - Bus and Bus Facilities Discretionary Grant
  - Low-or No-Emission Vehicle Grant
  - Metropolitan & Statewide Planning and Non-Metropolitan Transportation Planning
  - Urbanized Area Formula Grants
  - State of Good Repair Grants
  - Flexible Funding Program – Surface Transportation Block Grant Program
- Federal Highway Administration (FHWA)
  - Congestion Mitigation and Air Quality Improvement Program
- Environmental Protection Agency (EPA)
  - Environmental Justice Collaborative Program-Solving Cooperative Agreement Program

State

CityBus 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. See list of state-level funding opportunities that CityBus is aware of below:

- 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)
  - Solution for Congested Corridor Programs (SCCP)
- California Department of Transportation (Caltrans)
  - Low Carbon Transit Operations Program (LCTOP)
  - State Transit Assistance (STA) + STA SB1
  - Transportation Development Act
  - Transit and Intercity Rail Capital Program
  - Transportation Development Credits
  - New Employment Credit
- California Energy Commission
  - Blueprints
  - Infrastructure Funding

Local

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

- Local Return
  - Proposition A
  - Proposition C
  - Measure R
  - Measure M
- Regional Program Funds
  - Metro Measure R Municipal Regional Clean Fuel Bus Capital Facilities and Rolling Stock

I

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. While not all challenges can be foreseen, nearly all transit agencies must contend with the cost hurdles posed by these new zero-emission technologies. The current market cost of ZEBs is between $750,000 and $1,700,000, which is between double and triple the cost of traditional diesel buses. Additionally, the necessary infrastructure to support these buses adds to the financial burden of transitioning to a ZEB fleet, as outlined below in **Table 11.** CityBus will seek financial support to cover the incremental cost of ZEBs from the resources discussed in Section H.

Table 11 – Incremental Cost of CityBus' ZEB Transition (2021-2040)

Incremental cost of ZEB Transition (2021-2040)			
	ICE Baseline	ZEB Incremental Costs	ZEB Transition Scenario Costs
Bus Capital Expense	$171M	$150M	$321M
Fueling Infrastructure		$30M	$30M
Total	$171M	$180M	$351M

Support for the capital costs of new infrastructure is important for many agencies, but creating cost efficiencies for fueling operations cannot be overlooked. Engaging electric utilities and existing hydrogen networks, whether investor-owned or public, will be crucial for large-scale deployment of ZEBs, as subsidized or negotiated rate structures for electric vehicles aid the affordability of large-scale electrification. Electric utilities, in some cases, must also be educated on the scale of increases in energy demand and resultant grid upgrades warranted by large-scale transit electrification. Often, the existing electrical grid infrastructure cannot support the larger energy demands of powering an electric fleet, and utilities must plan and install new 12kV switchgears and/or new transformers.

CARB can support CityBus by ensuring continued funding for the incremental cost of zero-emission buses, as well as infrastructure funding and legislative support. These support activities 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 hurdles, 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.

APPENDIX A – Approved Board Resolution