Yolo County Transportation District

Zero Emission Bus Rollout Plan

June 2023

Contents

Section A. Agency Information

1. **Transit Agency name**	Yolo County Transportation District
2. **Mailing Address:**	350 Industrial Way, Woodland CA, 95776
3. **Transit Agency Air District**:	Yolo Solano Air Quality Management District
4. **Transit Agency Air Basin:**	Sacramento Valley Air Basin
5. **Maximum Buses in Service:**	26
6. **Urbanized Areas:**	Sacramento (1.1 million) Davis (66,799) Woodland (61,398)
7. **Contact Information:**	Autumn Bernstein Executive Director abernstein@yctd.org
8. **Part of a Joint Group**	No

Section B. Purpose of Innovative Clean Transit Regulation and Rollout Plan General Information

In December 2018, the California Air Resources Board (CARB) established the Innovative Clean Transit Regulation (ICT), which requires all public transit agencies to convert their fleet of bus vehicles to zero emissions by 2040. Within the ICT there are two sets of deadlines predicated on whether a transit agency is determined to be a large operator or a small operator. Transit agencies classified as large operators under the ICT would include attributes such as operating service with at least 100 buses in an urbanized area with a minimum population size of 200,000 or a transit agency that operates within the service area of South Coast or San Joaquin Valley Air

Basins with more than sixty-five buses as a large transit operator. Transit operators that operate with a fleet size of less than sixty-five buses irrespective of the population size are considered small transit operators. According to the operator size designations determined by CARB, Yolobus is classified as a small transit operator under the ICT regulations.

The projected timelines detailed in Section D (Current Bus Fleet Composition and Future Bus Purchases), Section E (Facilities and Infrastructure Modifications) and Section D (Workforce Training) are in alignment with the ICT deadlines for small transit operators to fully convert 100% of their bus fleet to zero emission before the 2040 deadline.

The ICT regulations also require that 100 percent of bus procurements from transit agencies beginning in 2029 be ZEB's. The contents in the ZEB rollout plan are meant to provide structure guidance and transparency for how Yolobus intends to meet the ZEB purchase requirement. This document is not considered final by the transit agency and could be subject to changes and revisions as needed. This plan will serve as a living document for Yolobus. While converting to 100% zero-emission buses, Yolobus intends to operate a blended fleet of compressed natural gas (CNG), Diesel, and battery electric buses. The Yolo Transportation District will comply with the California Air Resources Board's Innovative Clean Transit Regulation. Yolo Transit District intends to fully convert our bus fleet (comprised of CNG, Diesel, and Gasoline) to one hundred percent zero-emissions by 2040. The ZEB transition will be achieved by phasing out the current fleet of Diesel, CNG, and Gasoline buses, paratransit, and microtransit vehicles as they hit their threshold for useful life.

At the June 2023 Board Meeting, the Yolobus Zero-Emission Roll-out Plan was formally approved. Attached to the document is the approved board resolution signifying the public notice of the Zero-Emission bus plan and board approval.

If CARB would like to follow up with additional inquiries regarding the zero-emission bus rollout plan, they can reach out to Courtney Williams, Senior Transportation Planner at cwilliams@yctd.org

The Yolobus Zero Emission bus plan was created by Yolo Transportation District's Planning team. The fleet management schedule, and operational data used to support the justification for Yolobus transitioning to Zero-Emission buses was collected in-house using existing fleet data to track the mileage and useful life of all our vehicles.

Section C. Profile of Zero-Emission Bus Technology Portfolio

Yolobus operates local, intercity, express, and commuter service using a fleet of 48 full-size coach buses, nine paratransit vehicles, and eleven micro-transit vehicles. Yolobus will operate a mixed fleet of buses through 2040 which include battery electric buses, CNG buses, Diesel buses and paratransit vehicles, and micro transit vans that operate on gasoline. Of the 48 full-size coaches, currently six are zero-emission battery electric Proterra buses that were delivered in 2019. By the 2040 deadline Yolobus will complete the bus fleet conversion and will operate 100 percent using zero-emission buses. Below are two potential zero-emission bus styles and manufacturers that YoloTD have identified. These buses were selected to provide a comparison of range estimates, battery capacity, and overall build. Mentioning them in this document does not indicate that the agency prefers either manufacturer prior to formally soliciting procurement orders to purchase zero-emission buses. The figures and tables provide a comparison of the components in a 40' Gillig battery electric zero-emission bus and New Flyer battery electric zero-emission bus, their respective battery capacity, and vehicle statistics. YoloTD does not plan to convert any conventional Diesel or CNG buses into zero-emission buses.

The table below provides additional bus information including battery size, and mileage range estimates.

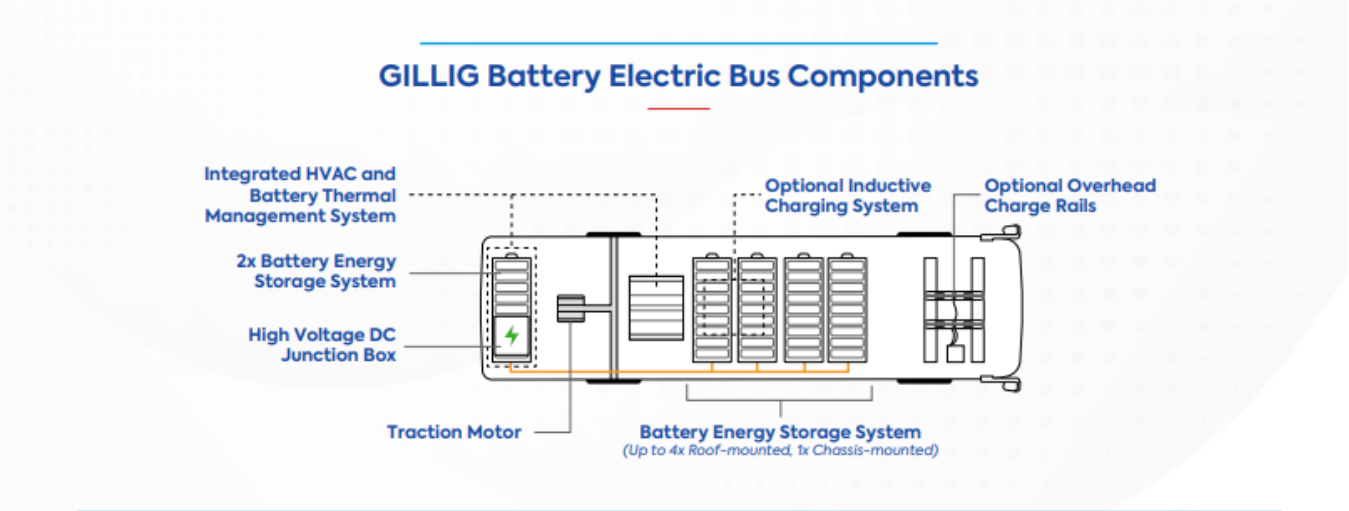

Figure 1. Gillig ZEB Internal Components

Bus Length	35'	40'
Battery Capacity	490 kWh, 588 kWh, 686 kWh	
Motor	Cummins Direct Drive, Permanent Magnet Motor	
Passenger Capacity (Seated / Total)*	31 / 62	38 / 75
Gross Vehicle Weight Rating	48,200 lbs.	48,200 lbs.
Maximum Height	135"	135"

Table 1. Gillig Zero Emission Bus Statistics

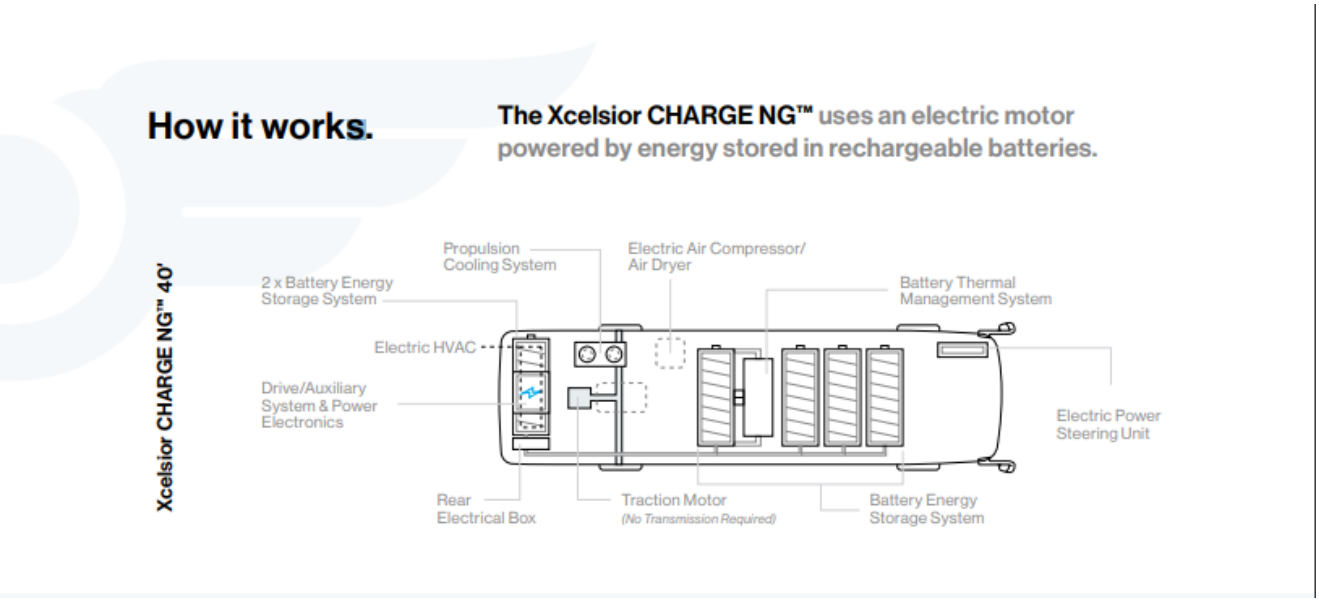

Figure 2. New Flyer Xcelsior Bus Components

Length	ESS (kWh)	Range (Miles)
35′	345 435	182 224
40′	345 435 520	178 221 258

Table 2. New Flyer Zero Emission Bus Size, Range and Battery Capacity

Mileage Breakdown for Yolobus Fixed Route Service

Yolobus provides fixed route bus service that includes intercity service, express service, and local bus service spanning the four largest cities in Yolo County, plus several rural routes and connections to key destinations in Sacramento County (downtown Sacramento, Sacramento International Airport, and UC Davis Medical Center). Planning for the transition to a 100 percent zero-emission fleet requires an understanding of potential service limitations prior to converting our fleet. For Yolobus, fixed route weekday service averages 170 miles driving per weekday trip driven. Saturday service averages 161 miles driving per Saturday trip driven and Sunday service averages 159 miles per Sunday trip driven. Tables three through six below break down the mileage runs buses will drive during both weekday and weekend service.

For weekday service, Yolobus operates 38 shifts that range in mileage from less than 100 miles to over 200 miles. Each shift would account for the total number of miles a bus would drive in a single day. Currently bus manufacturers estimate the range for their zero-emission buses to be 250+ miles. Assuming these figures are accurate, 88 percent of the weekday trips operated by Yolobus could be operated by zero-emission bus as a one for one replacement. The remaining twelve percent of shifts operated currently (using CNG and diesel buses) would need to be augmented by increasing the

number of weekdays shifts to reduce the total daily driven mileage or incorporate on-route charging infrastructure to provide flexible charging while operating fixed route service. Saturday Service operates 28 shifts with 96 percent of the shifts within the range estimates of zero-emission buses available today (200-250 miles). Saturday service operates with 89 percent of the trips driven ranging from 140-179 miles. With Saturday service operating at a higher range than the weekday service YoloTD planning staff will need to work together with our transit operations contractor to ensure that future Saturday shifts have a lower range threshold to accommodate zero emission buses. Sunday Service includes 27 shifts with 77 percent of the total shifts ranging from 140 to 179 miles. In total there are 93 shifts currently operated by Yolobus with 73 percent of the shifts (68) ranging from 140-179 miles. Fifty two percent of the total shifts are 160 miles or greater (49 total shifts) and six percent of the shifts operate at 180 miles or greater. With most of the shifts operated by Yolobus to be within the manufacturer range threshold for ZEB's, the YoloTD planning staff expect to coordinate with manufacturers and our operations contractor to ensure that there is a buffer between the number of miles needed to operate Yolobus service and the drivable range of the zero-emission buses expected to be purchased.

Range of Weekday Service Miles Driven	Number of Trips Driven
100 miles or less	8
101 miles-139miles	4
140 miles- 159miles	10
160 miles-179miles	12
180 miles-200miles	1
200+ miles	3
Total Weekday Service Trips Driven	38

Table. #3

Range of Saturday Service Miles	Number of Trips
100 miles or less	1
101 miles-139miles	1
140 miles- 159miles	10
160 miles-179miles	15
180 miles-200miles	0
200+ miles	1
Total Saturday Trips Driven	28

Table. #4

Range of Sunday Service Miles	Number of Trips
100 miles or less	2
101 miles-139miles	3
140 miles- 159miles	5
160 miles-179miles	16
180 miles-200miles	0
200+ miles	1
Total Sunday Trips	27

Table. #5

Range of Weekly Service (Monday-Sunday)	Number of Trips
100 miles or less	11
101 miles-139miles	8
140 miles- 159miles	25
160 miles-179miles	43
180 miles-200miles	1
200+ miles	5
Total Trips	93

Table. #6

Section D. Current Fleet Composition and Future Bus Purchases

The current Yolobus fleet for 2023 is presented below in Table 7. Yolobus has a total fleet of 48 buses that use three different fuel types to operate fixed route service. These fuel types include CNG, Diesel, and Electricity (Zero-

Emission battery electric bus). The blended fleet allows Yolobus to maximize range for the routes, have fueling resiliency, and the ability to pilot Zero-Emission Buses in real-time to analyze and monitor changes that would need to be implemented to transition to a full zero-emission fleet. Of the 48 buses four buses are currently out of service (three CNG and one Diesel) and require significant long-term repairs before they can be put back into service. Three of the four buses will not be fully repaired until July 2024 with the remaining bus expected to be back in service September 2023. Yolobus also operates paratransit and microtransit in addition to our fixed route service. Table 7 below provides a complete portfolio of the current vehicles operated by Yolobus.

Table 8 provides an overview, timeline, and purchase quantity of zero-emission buses needed to meet the ICT 2040 deadline with 2036 highlighted in green to indicate when Yolobus expects to achieve 100 percent replacement towards zero-emission buses. Tables 9 through 12 provide the replacement schedule for paratransit and microtransit vehicles to zero-emission. Tables 13 and 14 provide the cost per vehicle for both zero-emission buses, and zero-emission vehicles, the average mileage each vehicle would need to operate at, and the estimated total cost needed to fully comply with the ICT regulation. In total $82,650,000 in 2023 dollars is the estimated cost to fully replace our entire fleet with zero-emission buses, with $4 million of the total funds that need to be allocated to paratransit and microtransit vehicles. These cost estimates don't include charging infrastructure, energy storage, and other upgrades that need to be made to operate the zero-emission vehicles.

Manufacturer	*Year in Service*	*Fuel Type*	*Length*	*Bus Service Type*	*Number of Buses*	*Age (years)*
Orion	2008	CNG	40'	Fixed Service	11	14
MCI	2010	Diesel	45'	Fixed Service	6	12

Gillig	2017	CNG	40’	Fixed Service	9	5
Gillig	2018	CNG	40’	Fixed Service	8	4
Gillig	2019	CNG	40’	Fixed Service	8	3
Proterra	2019	Electric	40’	Fixed Service	6	3
					48	
El Dorado*	2016	Diesel	N/A	Paratransit	9	6
Glaval	2020	Diesel	N/A	Microtranist	3	2
Ford	2023	Gas	N/A	Mictrotransit	4	Delivered July 2023
Dodge	2023	Gas	N/A	Microtransit	4	Delivered July 2023
					11	

Table. 7 Yolobus Bus and Vehicle Fleet Total Vehicle Fleet

ZEB Purchase Year																
2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040

Table 8. Zero Emission Bus Purchase Schedule

Total Vehicles	**Paratransit Vehicle Replacement Schedule**																
	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
9								**9**									

Table 9. Zero Emission Paratransit Purchase Schedule

Total Vehicles	Glaval Microtransit Zero Emission Vehicle Replacement Schedule															
	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
3		**1**						**1**						**1**			

Table 10. Zero Emission Microtransit Purchase Schedule

Total Vehicles	Dodge Microtransit Zero Emission Vehicle Replacement Schedule															
	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
4						**4**											

Table 11. Zero Emission Microtransit Purchase Schedule

Total Vehicles	Ford Microtransit Zero Emission Vehicle Replacement Schedule															
	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
4						**4**											

Table 12. Zero Emission Microtransit Purchase Schedule

Projected Procurement Year	Zero-Emission Buses Purchased	Estimated Cost Per Bus	Estimated Total Cost	Estimated Mileage	Average Mileage to Operate Yolobus
2026	6	$950,000	$5,700,000	250+	170+
2028	8	$950,000	$7,600,000	250+	170+
2029	18	$950,000	$17,100,000	250+	170+
2034	3	$950,000	$2,850,000	250+	170+
2036	7	$950,000	$6,650,000	250+	170+
2037	6	$950,000	$5,700,000	250+	170+
2038	13	$950,000	$12,350,000	250+	170+
2039	8	$950,000	$7,600,000	250+	170+
2040	18	$950,000	$17,100,000	250+	170+
Estimated Total Cost			$82,650,000		

Table 13. Range and Estimated Costs of Future Zero Emission Bus Purchases Replacement Year and Replacement Amount

Procurement Year	Zero-Emission Paratransit Vehicles	Zero-Emission Microtransit Vehicles	Estimated Cost Per Vehicle	Estimated Total Cost	Estimated Mileage	Required Mileage to Operate
2025	0	1	$200,000	$200,000	150+	90+
2029	0	8	$200,000	$1.6 Million	150+	90+
2031	9	1	$200,000	$2 Million	150+	90+
2037	0	1	$200,000	$200,000	150+	90+
			Estimated Total Cost	$4 Million		

Table 14. Range and Estimated Costs of Microtransit and Paratransit Vehicles

Section E. Facilities and Infrastructure Modifications

Yolobus currently operates its transit service out of two locations. The headquarters is located at 350 Industrial Way, Woodland California and contains the planning administrative offices, dispatch offices, operations and bus driver facilities, maintenance facility, bus wash, two CNG fueling stations, and parking for full-size buses, paratransit, and microtransit vehicles. The site also has a miniature field with a track to provide an outdoor area for staff to have recreational breaks. The site can fit up to 60 buses, and eleven paratransit vehicles. Currently on site there are two battery electric chargers used to charge six of our battery electric buses. Previously, Moniz Architecture firm completed the engineering analysis for the primary Yolobus bus yard, although it is still being determined who will be the lead architect to design the necessary facility upgrades to complete the zero-emission conversion. The current site on Industrial Way contains enough space to fully convert our existing fleet to zero-emission and provides a charger in every other bus spot without the need to build or procure additional infrastructure. The current needs for the existing site include an overhead solar canopy to protect the buses, capture energy from the sun, and use that energy to charge the buses. The second component to the facility overhaul includes building the infrastructure to support charging for all replacement buses, paratransit and microtransit vehicles, while incorporating enough space to store the excess energy for at least three days, in addition to selling excess energy back to the grid. Building additional battery storage will enhance the resiliency of the bus fleet during blackout periods, natural disasters or other emergencies where energy availability might be limited. Currently YoloTD has a planning window from 2023-2025 to identify a zero-emission bus manufacturer, train our current maintenance technicians, and identify a contractor to complete the project components previously described. The expected timeline for completing installation of the solar canopy would be from 2024 – 2030. Completion of the infrastructure upgrades and battery storage will coincide with the infrastructure upgrades lasting from 2024-2030 and the battery storage improvements beginning in 2025 and concluding in 2033. Again, all dates provided are rough estimates at this time. Figure three

has three highlighted boundaries that cover the facility components listed in table 15. The green boundary includes bus parking, microtransit parking, both CNG fueling stations, and the recreational outdoor track. The red boundary includes additional bus and microtransit parking, the bus wash, and maintenance facility. The green boundary includes all the planning, service operations administrative facilities. Estimated construction would focus on the green and red boundaries. Figure four provides an arial view of Yolo bus's annex bus yard located in West Sacramento. This facility provides additional parking for Yolobus buses to reduce deadhead travel from the Woodland facility. Infrastructure improvements at the harbor site include a solar canopy and charging infrastructure accommodations to support zero-emission buses and remodeling the current facility to provide a space for dispatch and maintenance staff to work out of.

Division/Facility Name	Address	Function & Type of Infrastructure	Service Capacity	Upgrades	Estimated timeline for Construction
Yolobus Bus Yard and Maintenance Facility	350 Industrial Way Woodland CA,	Bus Yard and Maintenance Facility and Bus Wash	60 Buses 11 Paratransit Vehicles	Solar Panel Canopy Battery Storage Infrastructure Electrification Upgrades	2024-2030 2025-2033 2024-2030
Harbor Bus Yard	540 Harbor BLVD, West Sacramento, CA	Bus Yard	15 Buses 8 Paratransit/Microtransit vehicles	Solar Panel Canopy Infrastructure Electrification Upgrades	2024-2030 2024-2030

Table 15. Facility Upgrades

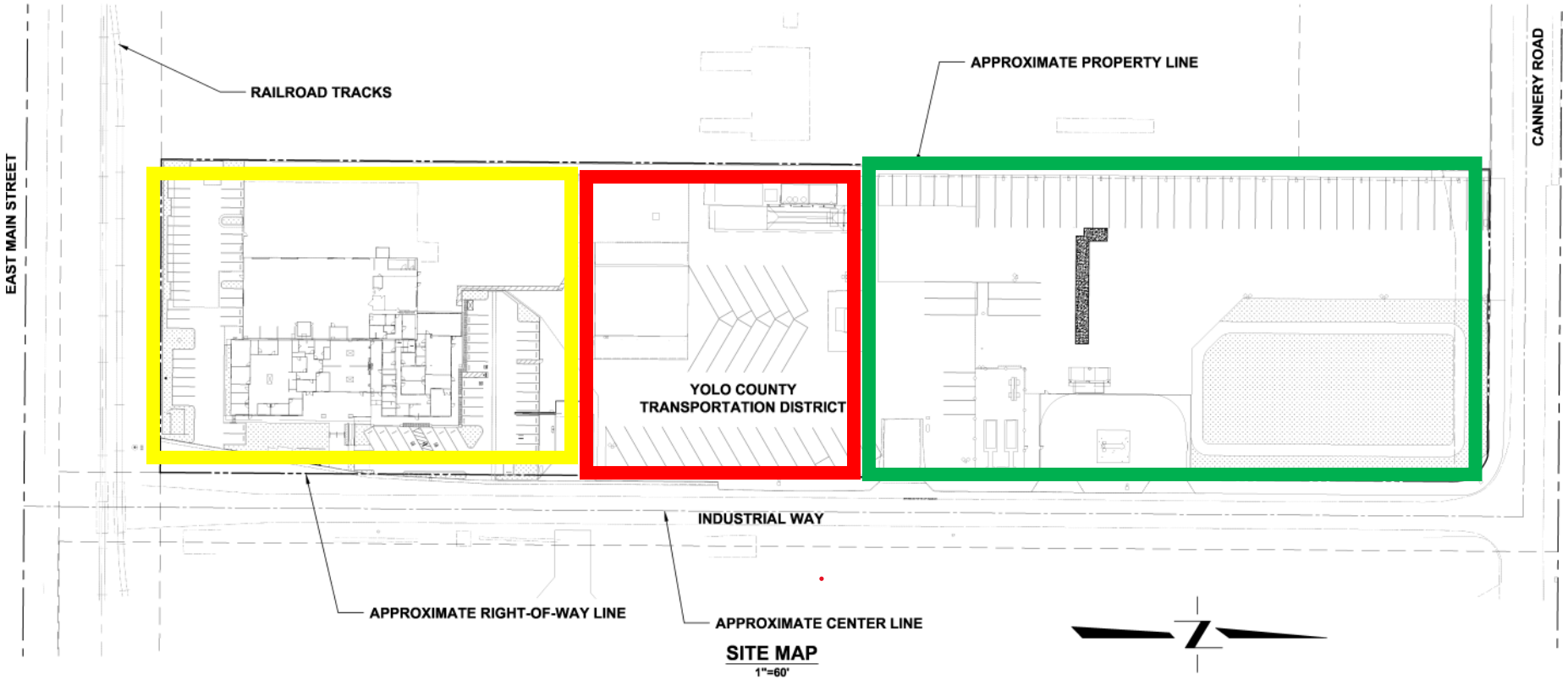

Figure 3. Current Site Map of Yolo Transportation District

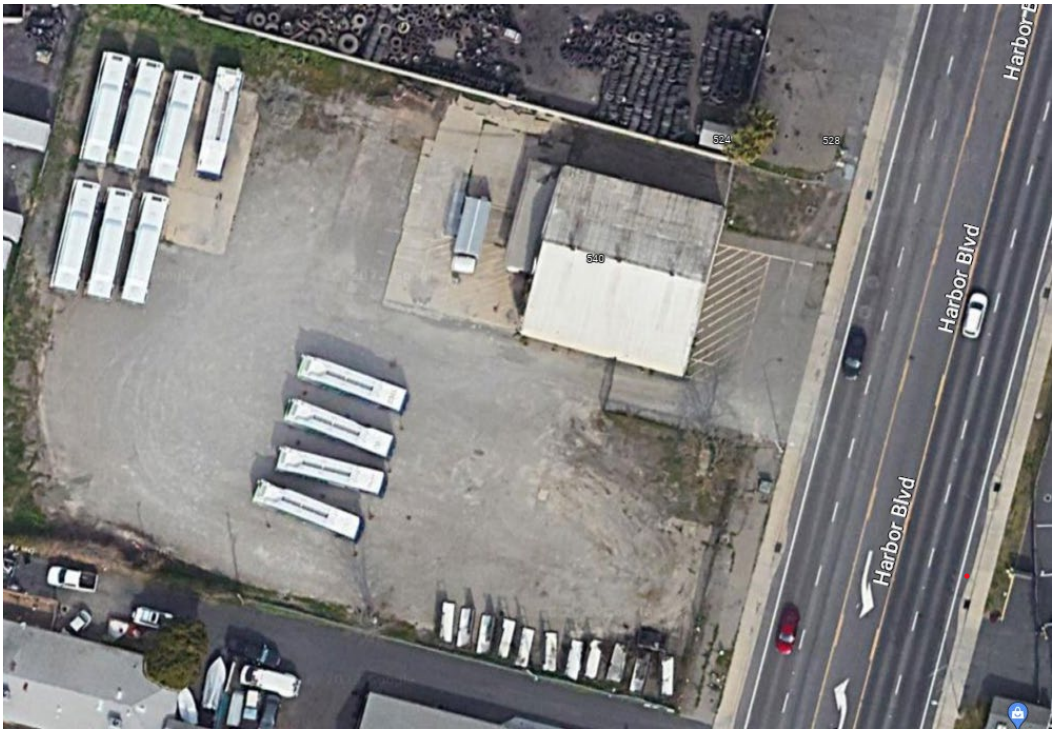

Figure 4. Harbor Bus Yard

Section F. Providing Service in Disadvantaged Communities

In 2006 the California state legislature passed Assembly Bill 32, establishing the requirement for California to reduce greenhouse gas emissions to 1990 levels by 2020, created the Cap-and-Trade Market and expanded the powers of CARB to adopt additional regulations and guidance to reduce statewide greenhouse gas emissions. Succeeding AB 32 was Senate Bill 535 (passed in 2012) which required 35 percent of the revenue collected from the Cap-and-Trade auction proceeds to create the California Climate Investments Program and provide benefits to disadvantaged communities. The California Environmental Protection Agency established the criteria used for identifying disadvantaged communities (also referred to as priority populations) which include using environmental, economic, and health indicators, and census tracts to measure the health of a community. Communities located within census tracts that score in the top 25th percentile of the aggregated criteria are classified as disadvantaged communities. Yolobus has one designated disadvantaged community located in West Sacramento. The map in figure

five provides the disadvantaged community map and a screenshot of the service area that Yolobus provides. Yolobus service area includes Davis, West Sacramento, Woodland, Dunnigan, Winters, Downtown Sacramento, Capay Valley, Cache Creek, Knights Landing, and Madison. Yolobus services one disadvantaged community (West Sacramento/Downtown Sacramento) within the service area. Routes 37, 40, 41, 240, 42A, and 42B all serve stops within the designated disadvantaged community. While no zero-emission buses currently service a disadvantaged community once the zero-emission buses are delivered Yolobus will be operating ZEB's within DAC's once the buses are delivered.

Zero Emission Buses Serving Disadvantaged Communities			
Routes that service DAC's	Location of Disadvantaged Community	Number of Zero Emission Buses Currently Deployed to service DAC's	Estimated Year buses will be deployed to serve Disadvantaged Communities
37	West Sacramento/Downtown Sacramento	0	2026
40	West Sacramento /Downtown Sacramento	0	2026
41	West Sacramento/Downtown Sacramento	0	2026
240	West Sacramento/Downtown Sacramento	0	2026
42A	West Sacramento/Downtown Sacramento	0	2026
42B	West Sacramento/Downtown Sacramento	0	2026

Table 17. Yolobus Routes that Service Disadvantaged Communities

Priority Population Map of Yolobus Service Area

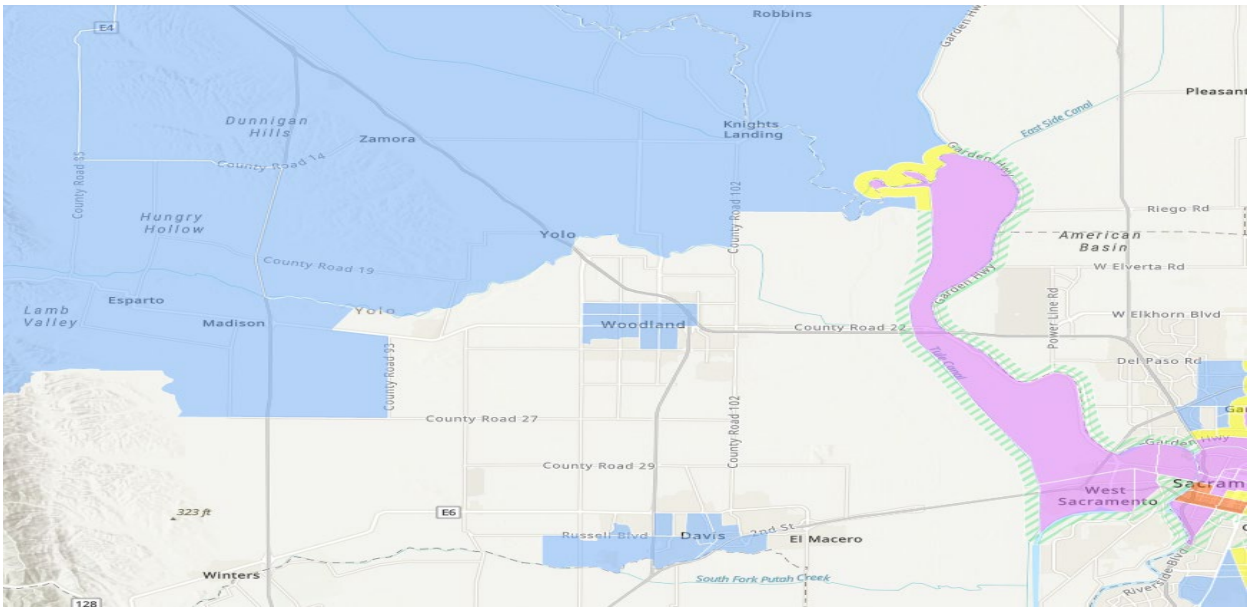

Figure 5 https://webmaps.arb.ca.gov/PriorityPopulations/ Map of Yolobus Service Area

Section G. Workforce Training Schedule

YoloTD staff plan to use a three-year planning window between 2023-2025 to schedule the workforce development, training, recruitment needs, hiring and training to build the operational and maintenance capacity to troubleshoot issues from ZEB's caused by normal road wear or other issues. With six battery electric buses currently in use, Yolobus has already begun training current maintenance staff to service our ZEB's. Yolobus intends to use the newly hired ZEB maintenance technician to lead training assignments for our maintenance team and teach them how to diagnose computer errors, conduct proper safety procedures for working on battery electric buses, and best practices doing on-site inspections, using specialized tools for advanced bus technology components, preventative maintenance inspections, and developing a training curriculum. These components are neither comprehensive nor exhaustive, however they do reflect what Yolobus maintenance team have initiated to increase the overall technical capacity when servicing zero-emission buses. Yolobus currently has ten maintenance staff to manage a fleet of 48 buses six of which are zero-emission battery electric Proterra 40' buses.

Training Category Year	2023	2024	2025
Dedicated ZEB Maintenance Technician Provides Maintenance team with overview of Current Fleet of ZEB's			
Dedicated ZEB Maintenance Technician Provides Maintenance team with Preliminary training, and safety overview			
Dedicated ZEB Maintenance Technician Provides Maintenance team with Diagnostic testing, and ZEB servicing			
Dedicated ZEB Maintenance Technician Provides Maintenance team with overview of Current Fleet of ZEB's			
Full Maintenance team is Introduction to new ZEBs			
OEM Provides overview of technical layout of ZEBs for future bus purchases (in person)			
OEM Assists with Onsite maintenance, preventative maintenance inspections, and develops troubleshooting guides and manuals			
Maintenance staff take over maintenance inspections, vehicle maintenance with OEM Supervising			
All Maintenance for ZEB's is completed by Yolobus technicians. Manuals, tools, and specialized equipment is purchased, and all maintenance staff are fully trained on how to use the equipment			
Maintenance Staff have created and implemented a full training module to train new maintenance employees on how to operate fully battery electric buses. Periodic check-ins from OEMs to share best practices and ongoing service inquiries.			

Table 18. Workforce Training Schedule

Section H. Potential Funding Sources

Yolobus plans to pursue all available funding sources available to support the procurement of ZEBs and supporting infrastructure improvements needed to fully convert our fleet to zero-emissions to meet the 2040 ICT deadline. Available funding sources are categorized in three categories based on the funding source (Federal, State, Local) whether the sources have competitive or formula funding criteria, and criteria specific grant programs. The table provided below highlights the existing grant program and funding sources that Yolobus will plan to pursue and obligate funding towards to support the zero-emission vehicle procurement, charging installation, and infrastructure expansion needed. In the table below, programs highlighted in blue represent formula programs that are distributed annually, and programs highlighted in green reflect discretionary competitive grant programs.

Funding Source	Funding Program
Federal Funding	Better Utilizing Investments to Leverage Development (BUILD) Grants
	Capital Investments Grants- New Starts
	Capital Investments Grants – Small Starts
	Bus and Bus Facilities Discretionary Grant
	Low or No Emission Vehicle Grant 5339
	Metropolitan & Statewide Planning Metropolitan Transportation Planning grants
	Urbanized Area Formula Grants 5307
	State of Good Repair Grants
	Flexible Funding Program – Surface Transportation Block Grant Program
	Congestion Mitigation and Air Quality Improvement Program
	Environmental Justice Collaborative Program Solving Cooperative Agreement Program
	Design Intelligence Fostering Formidable Energy Reduction and Enabling Novel Totally Impactful Advanced Technology Enhancements

State Funding	Hybrid and Zero Emission Truck and Bus Voucher Incentive Project (HVIP)
	State Volkswagen Settlement Mitigation
	Carl Moyer Memorial Air Quality Standards Attainment Program
	Solutions for Congested Corridor Programs (SCCP)
	Low Carbon Transit Operations Program (LCTOP)
	Transportation Development Act
	Transit and Intercity Rail Capital Program (TIRCP)
	Transportation Development Credits
	New Employment Credit
Local Funding	SACOG regional Discretionary Program Funding

Table 18. Identified Funding Sources

Section I. Start Up and Scale Up Challenges

The challenges associated with transitioning to a new energy source and infrastructure could affect Yolobus service operations, maintenance staff, workforce development training, energy costs, and resiliency to natural disasters. While these issues are expected during the transition phase, Yolobus has provided recommendations for CARB to assist Yolobus and other transit agencies.

Challenges with Service Operations

Currently Yolobus operates six zero-emission buses as a joint commuter service with Sacramento Regional Transit using battery electric buses to transport passengers from UC Davis (in Davis, CA) to the UC Medical Center (Sacramento, CA). During June-August 2022 one of the buses overheated and shut down while in service on the causeway that links Davis to West Sacramento. During the diagnosis it was identified that due to the bus being stored outdoors uncovered, the electrical components housed on the top of the bus, and the software used to monitor battery temperatures were exposed to long durations of 90+ degree temperature sunlight leading to a complete shut-down of the vehicle while in service. Another unknown is the projected ranges of buses offered by bus manufacturers and the true range

experienced during real driving conditions. With 90 percent of the trips driven by Yolobus within the expected range advertised for zero-emission buses, YoloTD still needs to ensure that other weather issues would not encumber service resiliency before Yolobus transitions to Zero-Emission buses. Disaster preparedness is a requirement for all transit operators.

Transitioning Bus Fleet to a Low Energy Dense Fuel Source and Battery Capacity Constraints

The current technological profile for Yolobus includes three energy sources, which include compressed natural gas, straight gas, and diesel. For the fixed route service this includes CNG and Diesel. The energy output per mile associated with each energy source is in the table below. Outlining the energy density will provide an estimate to forecast the energy cost and energy expenditure to operate current Yolobus service determined by the number of hours and miles driven in a calendar year. For Yolobus the ICT requirement increases the overall energy expenditure to operate service when compared to operating our current blended fleet of buses. Currently our six electric buses provide the lowest energy output (megawatt per kilojoule) of energy. CARB using funds from the greenhouse gas reduction fund to finance research towards improving energy density from carbon neutral energy providers, and improving the capacity and charging speed of battery technology would provide resilience and relief for transit operators to ensure long-term operations of battery electric zero-emission technology. The tables below reflect the energy type and energy output for the different fuels used to operate the Yolobus fleet. A complete conversion towards zero emission battery electric technology would result in a reduction of energy density when compared to using diesel, CNG, or gasoline. To account for the loss of energy density, an increase in the capacity of battery storage is needed to maintain resilient operational service.

Energy Type	Energy Output (MJ/KG)	# of Buses
Diesel	45.5	6
Compressed Natural Gas	53.6	32
Gasoline	45	0
ZEB Electric (492 KWh)	8.9	6

Table 19 Energy Density of Current Bus Fleet

Battery Electric Bus	**Kilowatt Hours (Battery) (KWh)**	**Energy Output (WH/KG)**	**Energy Output (MJ/KG)**
New Flyer 40’	350	1260	4.54
New Flyer 40’	440	1584	5.7
Gillig 40’	490	1764	6.4
Gillig 40’	588	2116.8	7.6
Gillig 40’	686	2469.6	8.9

Table 20 Energy Density of Proposed Zero Emission Bus Fleet

Current Financial Costs and Constraints to Operating Battery Electric Buses

From April 2021 through March 2023, Yolobus operated six battery electric buses on a specialized commuter service (Route 138) that runs between the Mondavi Center in Davis, CA and the UC Davis Medical Center in Sacramento, CA. The round-trip length is 23 miles and operates daily Monday through Friday.

The average cost to operate six buses from April 2021-March 2023 using two 800-volt 350kw ABB chargers was $4,028.91 per month, with an average price of 34 cents per Kilowatt Hour and a monthly average use of 12,145.38 Kilowatt Hours consumed. These averages include periods of service operation when one or a few of the six buses were out of service and if one of the chargers were not available to charge the buses. These prices also

include charging during peak, off-peak, and Super-off peak charging times offered by Pacific Gas and Electric (PG&E).

Future Operating Charging Costs for Fully Converted Battery Electric Fleet:

YoloTD staff estimated the annual cost to operate a fully battery electric bus fleet to be $783,921 in 2023 dollars.

Annual Charging Cost Calculation Estimate.

Inputs	Variables
Total ZEB miles driven over 2 years: 216,046	= A
Total KWHs consumed over 2 years: 291,489	= B
Total CNG Fleet Miles over 2 years 3,258,161	= C
Average Price per KWH = $.34	=D

Miles to KWH on ZEB's:	291,489/216,046=1.349 KWHs per mile = E
Total CNG Miles times KWH per mile:	C * E = 4,395,259 KWHs per mile = F F= 1,494,388

Outputs and Calculations	
Total Yearly cost to Charge fixed fleet	Total cost divided by 2 to calculate yearly cost. 1,494,388/2 G/2 = $747,194.06 For fixed fleet H= $747,194.06
Total Cost to Charge ZEB's Per Year	A/2 = 108,023 Miles I= 108,023 I*= $36,727.82 = $36,727.82

Final Total	
Total Combined Annual Charging Cost Estimate	H + J = $783,921.88

Table 21 Charging Cost Calculation Estimate

Please note the mileage and charging estimates include the miles needed to operate paratransit and fixed route service in 2023 dollars, using 2023 prices. This estimate does not account for the potential energy spikes during peak charging times, heavy load demand from the grid, or future energy prices. The estimate does not include costs for installation and maintenance of charging infrastructure. Table 22 provides a historical record of the PG&E bills received to calculate the monthly averages for KWH's consumed, average KWH used per month, cost per kwh per month, and monthly cost to charge the battery electric buses.

Year	Month	Total KWH	Total Cost	$ per KWH	Total Average $per KWH
2021	April	**16,558.08**	**$ 7,514.25**	**0.45**	
2021	May	**17,972.40**	**$ 7,701.78**	**0.43**	
2021	June	**17,445.36**	**$ 3,511.83**	**0.20**	
2021	July	**11,951.04**	**$ 2,812.20**	**0.24**	
2021	August	**12,612.64**	**$ 2,884.97**	**0.23**	
2021	September	**15,142.08**	**$ 3,195.38**	**0.21**	
2021	October	**16,712.64**	**$ 3,397.84**	**0.20**	
2021	November	**14,854.64**	**$ 6,613.67**	**0.45**	
2021	December	**14,719.20**	**$ 6,452.94**	**0.44**	
2022	January	**13,871.76**	**$ 6,464.14**	**0.47**	
2022	February	**13,638.64**	**$ 3,128.10**	**0.23**	
2022	March	**15,344.64**	**$ 3,915.32**	**0.26**	
2022	April	**14,595.04**	**$ 3,770.88**	**0.26**	
2022	May	**12,258.88**	**$ 7,143.42**	**0.58**	
2022	June	**12,174.88**	**$ 3,373.57**	**0.28**	
2022	July	**11,551.12**	**$ 3,304.55**	**0.29**	

2022	August	**9,949.44**	**$ 3,087.89**	**0.31**	
2022	September	**9,351.76**	**$ 2,975.21**	**0.32**	
2022	October	**9,194.80**	**$ 2,858.10**	**0.31**	
2022	November	**4,534.00**	**$ 2,152.33**	**0.47**	
2022	December	**4,180.64**	**$ 2,029.33**	**0.49**	
2023	January	**9,793.76**	**$ 3,172.00**	**0.32**	
2023	February	**6,383.68**	**$ 2,636.93**	**0.41**	
2023	March	**6,697.92**	**$ 2,597.32**	**0.39**	
					.34

Table 22. Aggregated Costs to Charge Battery Electric Buses

Scaling Challenges and CARB Recommendations

Yolobus intends to address scaling challenges through the procurement schedule provided on pages 11 and 12. Yolobus will phase procurement orders over ten years, align the necessary capital improvements needed to expand energy capacity, charging capacity, and energy storage before final delivery of the zero emission buses are received in 2036. However, the abilities of manufacturers to construct zero-emission buses quick enough to meet the ICT 2040 deadline could be a potential issue if the industry is subject to construction delays caused by high-inflationary market, supply chain shortages, or a financial recession. These potential scenarios will all be accounted for as YoloTD finalizes the planning and procurement orders for zero-emission buses, zero-emission paratransit, and zero-emission microtransit vehicles. Additionally, there are now reported issues from PG&E notifying cities to limit their development growth due to grid capacity issues. Recommendations for CARB would include:

- Establish a transit energy partnership between CARB, Public Utilities Commission, California Energy Commission, California energy providers (PG&E and Edison) and transit agencies to provide a space to share best practices and collaborate on regional transit energy solutions.
- Work with the CPUC to establish energy price caps for ICT compliant transit agencies. The price cap would prevent energy providers from charging market rate prices for ICT compliant transit agencies during extreme weather events or other situations where electricity supply is insufficient to meet demand. This would ensure that public transit agencies are not subjected to sporadic price spikes during peak charging hours and ensure stable financial planning for paying the associated energy costs to operate a fully zero-emission fleet.
- Lobby for expedited right of way acquisitions and streamlined infrastructure policies that expedite the process for acquiring land to build additional infrastructure for projects that aid transit agencies towards meeting the 2040 ICT ruling.

YOLO COUNTY TRANSPORTATION DISTRICT

RESOLUTION No. 2023-09

Resolution Authorizing the filing and execution all necessary documents on behalf of the Yolo County Transportation District of Grant Applications with to the California Air Resources Board (CARB) Innovative Clean Transit (ICT) Regulation and Execution of Related Agent Forms

WHEREAS, The State of California moves towards adopting ambitious public transportation sector and climate policy to reduce Green House Gas Emissions; and

WHEREAS, The California Air Resources Board (CARB) adopted the Innovative Clean Transit (ICT) regulation on December 14th, 2018 and

WHEREAS, the ICT regulation requires transit agencies in California to begin converting to zero-emission buses (ZEBs) by 2040; and

WHEREAS, each transit agency must submit a rollout plan under the regulation demonstrating how it plans to purchase zero emission buses, build out necessary infrastructure, and train the required workforces; and

WHEREAS, CARB requires the submittal of rollout plans by July 1st 2023;

NOW, THEREFORE, IT IS HEREBY RESOLVED, ORDERED, AND FOUND by the Board of Directors of the Yolo County Transportation District, County of Yolo, State of California, as follows:

1. YoloTD is authorized to develop and submit the ZEB rollout Plan

2. The YoloTD Director is authorized to execute the documents related to the ICT and ZEB Rollout Plan.

3 YoloTD agrees to comply with all conditions and requirements set forth in the documents and applicable statutes, regulations and guidelines pertaining to the ICT.

PASSED AND ADOPTED by the Board of Directors of the Yolo County Transportation District, County of Yolo, State of California, this 12th day of June, 2023, by the following vote:

AYES: 5
NOES: 0
ABSTAIN: 0
ABSENT: 0

Tom Stallard, Chair
Board of Directors

ATTEST:
Heather Cioffi, Clerk
Board of Directors

Approved As To Form:
Kimberly Hood, District Counsel