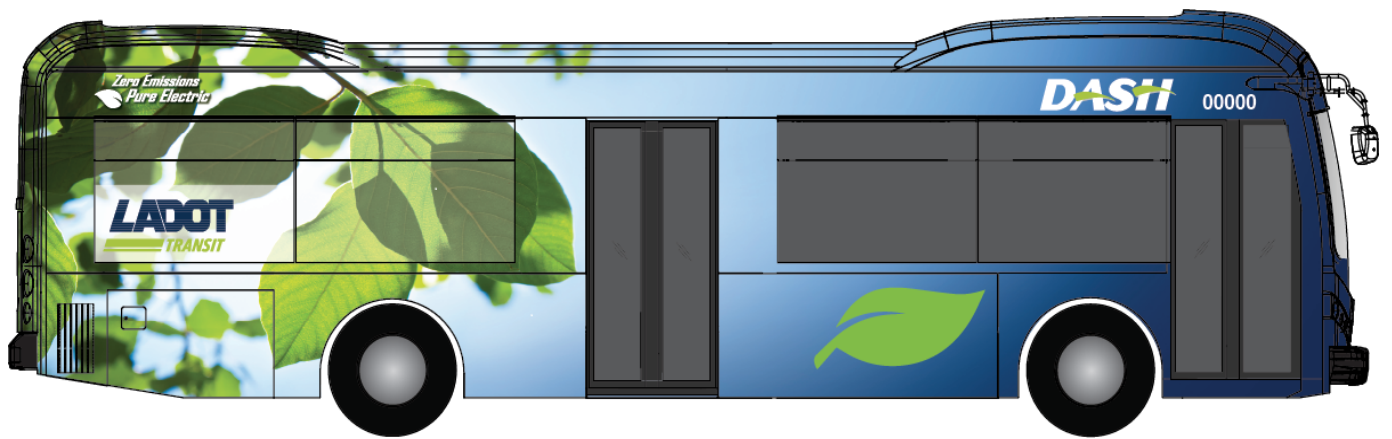


LADOT Transit ZERO-EMISSION BUS ROLLOUT PLAN



October 2020



Contents

LADOT Transit..... 1

ZERO-EMISSION BUS ROLLOUT PLAN..... 1

1 Section A: Transit Agency Information 3

2 Section B: Rollout Plan General Information 3

3 Section C: Technology Portfolio..... 4

4 Section D: Current Fleet and Future Bus Purchases..... 7

5 SECTION E: FACILITIES AND INFRASTRUCTURE..... 13

6 SECTION F: DISADVANTAGED COMMUNITIES 21

7 SECTION G: WORKFORCE TRAINING 28

8 SECTION H: POTENTIAL FUNDING SOURCES 30

9 SECTION I: START-UP AND SCALE-UP CHALLENGES 34

APPENDIX A: CITY OF LOS ANGELES BOARD RESOLUTION

1 Section A: Transit Agency Information

Transit Agency's Name	LADOT Transit
Mailing Address	100 S. Main Street, 10 th Floor Los Angeles, California 90012
Transit Agency's Air District	South Coast Air Quality Management District
Transit Agency's Air Basin	South Coast Air Basin
Total number of buses in Annual Maximum Service ¹	365
Urbanized Area	Los Angeles - Anaheim
Population of Urbanized Area ²	3,949,776
Contact information of general manager, chief operating officer, or equivalent	Seleta J. Reynolds General Manager (213) 972-8480 Seleta.Reynolds@Lacity.org

2 Section B: Rollout Plan General Information

Rollout Plan Content	
Is your transit agency part of a Joint Group ³	No
Is your transit agency submitting a separate Rollout Plan specific to your agency, or will one Rollout Plan be submitted for all participating members of the Joint Group?	N/A
Please provide a complete list of the transit agencies that are members of the Joint Group (optional)	N/A
Contact information of general manager, chief operating officer, or equivalent staff member for each participating transit agency member	N/A
Does Rollout Plan have a goal of a full transition to ZE technology by 2040 that avoids the early retirement of conventional transit buses?	Yes
Rollout Plan Development and Approval	
Rollout Plan's approval date	11/04/20
Resolution No.	City of Los Angeles Council file: 20-1348
Is a copy of the Board-approved resolution attached to the Rollout Plan?	Yes (Appendix A)
Contact for Rollout Plan follow-up questions	Kari Derderian Supervising Transportation Planner II Transit Development & Data Group (213) 928-9741 Kari.derderian@lacity.org
Who created the Rollout Plan?	LADOT Staff
Consultant	N/A

3 Section C: Technology Portfolio

3.1 INTRODUCTION

Per the California Air Resource Board’s Innovative Clean Transportation regulation (ICT), the following report serves as LADOT Transit’s Rollout Plan to transition its bus fleet to 100 percent zero-emission buses (ZEB) by 2040. The City of Los Angeles Mayor and City Council requires the City of Los Angeles Department of Transportation (LADOT) Transit to transition its bus fleet to 100 percent zero-emission by 2030 or sooner. LADOT Transit’s Rollout plan will use the City’s mandate of 2030 as LADOT Transit’s target date, a full ten years sooner than the ICT regulation requirement.

3.2 BACKGROUND

3.2.1 CALIFORNIA AIR RESOURCE BOARD’S INNOVATIVE CLEAN TRANSPORTATION REGULATION

The California Air Resource Board’s (CARB) Innovative Clean Transportation (ICT) regulation requires all public transit agencies in the State of California to transition from conventional buses (compressed natural gas, diesel, etc.) to zero-emission buses (battery-electric or fuel cell electric) by 2040. The regulation requires a progressive increase in new bus purchases to be zero-emission buses (ZEBs) based on the transit agency’s fleet size. By 2040, CARB expects all transit agencies in the state to be operating only ZEBs.

To ensure that each agency has a strategy to comply with the 2040 requirement, the ICT regulation requires each agency, or a coalition of agencies (“Joint Group”), to submit a ZEB Rollout Plan (“Rollout Plan”) before purchase requirements take effect. The Rollout Plan is a living document that guides the implementation of ZEB fleets and helps transit agencies work through many of the potential challenges and explore solutions. Each Rollout Plan must include several required components (as outlined in the Rollout Plan Guidelines) and approved by the transit agency’s governing body through the adoption of a resolution, before submission to CARB.

LADOT Transit must comply with the following requirements under the ICT regulation for large agencies (100 + bus fleet):

- **July 1, 2020** – Board-approved Rollout Plan must be submitted to CARB
- **January 1, 2023** – 25 percent of all new bus purchases must be zero-emission
- **January 1, 2026** – 50 percent of all new bus purchases must be zero-emission
- **January 1, 2029** – 100 percent of all new bus purchases must be zero-emission
- **January 1, 2040** – 100 percent of the fleet must be zero-emission
- **March 2021 – March 2050** – Annual compliance report due to California Air Resources Board (CARB)



3.2.2 CITY OF LOS ANGELES ZERO-EMISSION BUS MANDATE

The City of Los Angeles is committed to reducing greenhouse gas (GHG) emissions in the City of Los Angeles. In November 2017, The City Council approved a directive to transition LADOT Transit's fleet to zero-emission battery-electric buses (BEBs) by 2030 if not sooner. This is ten years sooner than CARB's Innovative Clean Transit (ICT) regulation. Since 2019, LADOT is only purchasing BEBs to meet the City's 2030 mandate.

Mayor Garcetti's L.A.'s Green New Deal pLAN (pLAN), offers a variety of initiatives to address climate change. The conversion to BEBs by LADOT Transit is included in the pLAN. The reduction of GHG emissions from BEBs offers a direct benefit to our residents particularly those in disadvantaged communities. A Clean Fuel policy and Mandate provides a concrete action to directly reduce air pollution.

3.2.3 LADOT CHOOSES BATTERY-ELECTRIC BUSES

LADOT Transit hired a consultant to prepare a market analysis of battery-electric buses to evaluate the current state of BEBs in the United States that meet federal requirements. The LADOT Electric Bus Market Research Analysis Report concluded:

- Four manufacturers with batteries that have sufficient range to meet our 110 mile-a-day range for our DASH program.
- Battery charging technology has advanced to allow LADOT to recharge the batteries faster thus allowing for overnight depot charging as opposed to in-route opportunity charging.
- Converting from internal combustion engines to battery-electric propulsion will require additional improvements and investments in terms of upgrades to

the power supply of the facilities.

- BEBs have lower operating costs (maintenance plus energy cost) with a Total Cost of Ownership for an electric bus is \$100,000 less than a CNG bus over the 12-year useful life.
- If the current LADOT fleet (not including the DASH expansion) were replaced with BEBs, this would have the effect of removing CO2 emissions of 2,365 cars and 21 kilograms of particulate matter is not discharged into the atmosphere. With these conclusions, LADOT Transit is confident that the currently available BEBs have the necessary range to meet our DASH service parameters, the ability to charge overnight, a lower Total Cost of Ownership, and finally will significantly reduce harmful GHG emissions.

3.2.4 LADOT EXISTING ZERO-EMISSION BUS EFFORTS

LADOT Transit is an early adopter of zero-emission battery-electric buses. With the aid of a CEC grant, LADOT Transit deployed four Build Your Dream (BYD) 35' battery-electric buses in Downtown Los Angeles. The batteries provide an adequate range for our LADOT Transit's service parameters. LADOT Transit is confident that the current battery technology can meet our service parameters for standard, over-the-road, and cutaway buses. LADOT Transit began applying for local, state, and federal grants for BEB and electrification infrastructure. LADOT Transit was awarded several grants and began procuring BEBs. Current procurement efforts include:

- Contract with Proterra for twenty-five 35' BEBs. Delivery by November 2020.
- Contract with BYD for 130 30' BEBS. Delivery by March 2021.
- AECOM is preparing a 30% design infrastructure plan for our three city-owned bus maintenance facilities.
- The City of Los Angeles Department of Water and Power (LADWP) is providing charger rebates and power to the three city-owned bus maintenance facilities.
- CALSTART prepared a *Full Bus Facility Electrification Analysis and Implementation Plan* that provides bus yard modifications, installation of charging infrastructure, and changes to operations at each bus yard.
- Awarded grants for over 200 BEBs that include standard, over-the-road, and cutaways buses from a variety of local, state, and federal grant programs.
- Awarded \$10 million in grant funds for electrification infrastructure at our city-owned bus yards.



4 Section D: Current Fleet and Future Bus Purchases

4.1 LADOT Services

LADOT Transit is the second-largest transit operator in Los Angeles County with over 370 buses. LADOT Transit is set to expand service and increase bus frequencies on its DASH system. These changes will add 131 buses to LADOT’s fleet.

4.1.1 LADOT Transit

LADOT Transit began providing service over 30 years ago, starting with the consolidation of City-operated dial-a-ride services for older adults and persons with disabilities and followed by the assumption of the Downtown Mini-Ride shuttle service in 1985. LADOT Transit is now Los Angeles County’s second-largest transit operator providing commuter, local and specialized transit services. LADOT operates 31 DASH circulator routes, 14 Commuter Express routes, Cityride paratransit services for older adults and persons with disabilities, and LAnow a new on-demand shared-ride service in the City of Los Angeles.

Fixed-Route System

LADOT Transit provides an extensive program of fixed-route services comprised of 14 peak-period Commuter Express routes, 5 DASH Downtown LA routes, and 26 Community DASH routes. Also, LADOT Transit operates the Union Station/Bunker Hill Shuttle for Metrolink and Metro Gold Line riders. Summary descriptions of the various services by type are provided below.



LADOT Transit operates fourteen Commuter Express routes as well as the Union Station/Bunker Hill Shuttle, which operates within Downtown Los Angeles using Commuter Express buses at the beginning or end of their runs. Commuter Express routes generally operate between 5:30 AM and 8:30 AM and then between 3:30 PM and 7:00 PM on weekdays only, with the exception of 142 which runs all day every day. No service is provided on the following holidays (with the exception of 142): New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day. The Commuter Express service operates CNG-powered over-the-road coaches to offer commuters a premium-services to entice solo drivers to ride transit.



DASH Downtown Los Angeles operates in the greater Downtown Los Angeles area with five routes that run Monday through Friday between 6:30 AM and 6:30 PM (till 7:00 PM for Routes D and E). On Saturdays and Sundays, Routes E and F operate between the hours of 10 AM and 5 PM (6:30 AM for Route E on Saturdays.) Downtown DASH service is not provided on New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

Community DASH operates 26 routes outside of Downtown LA that either serve a single community or link adjacent communities within the City of Los Angeles. A few routes also serve adjacent communities outside the City. Community DASH routes typically operate between 6 AM and 9 PM, with slight variations. The DASH program uses CNG-powered and Propane –powered 30’-35’ standard buses.

Expansion of DASH Routes and Increased Frequency

LADOT Transit was approved to add four new DASH routes and to increase the frequencies on our Community DASH routes from 30 – 20 minutes to 15 minutes. This expansion requires an additional 131 additional buses growing our fleet size from 361 to 492. The 131 expansion buses and 24 replacement buses are on order. All 155 buses are BEBs.



Demand-Response Paratransit Service

LADOT provides a citywide demand responsive paratransit service, Cityride, for older adults who are 65 years of age or older and for persons with disabilities. It operates Monday through Friday between 6:30 AM and 4:30 PM. Service is not available on the following holidays: New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

There are three service areas within the City, and service is also provided in some areas of unincorporated Los Angeles County adjacent to the City (Kagel Canyon, Calabasas, Topanga, Marina del Rey, and areas near Carson

and Long Beach. Riders pay for their trips using a discounted fare value - \$2 for a group trip, \$4 for an individual trip up to 10 miles, and \$6 for an individual trip over 10 miles. Participants can register for the program and make payments by mail, online, or through a mobile application. Cityride participants can also use their discounted fare value to use City-franchised taxicabs to make trips at any time, including weekends and holidays. Cityride participants also ride free on DASH.

Cityride also operates two fixed-route services: Via Marisol, which operates Monday through Friday from 9 AM until 2 PM; and Park La Brea, which operates Tuesdays and Thursdays from 10 AM until 4 PM. The fixed-route service charges the same fares as DASH. Cityride currently uses CNG-powered and gasoline-powered cutaways to operate service.



LANow On-Demand Shared-Ride Service operates in the Mar Vista, Venice, Del Rey, and Palms areas of the westside of Los Angeles. The service operates Monday through Friday from 6 AM to 7 PM. Six 23' cut-a-way ADA accessible vehicles are deployed during peak hours (6 AM – 9 AM, 4 PM – 7 PM) and four vehicles are deployed during off-peak hours (9 AM-4 PM). The service provides a digital reservation system, which riders use to book a ride up to seven days in advance, through a phone application, webpage, or call center. Riders are then picked up at virtual pick-up/drop-off locations. There are over 600 virtual pick-up/drop-off locations throughout the service area, ensuring a rider will not have to walk more than a quarter-mile to be picked up. LADOT began the LANow on-demand pilot project on March 11, 2019. LANow uses CNG-powered cutaways to operate service.

4.1.2 LADOT Current Fleet

The following section provides an overview of LADOT Transit's current bus fleet, the justification for ZEB technology, and a ZEB procurement schedule through 2030. As of August 2020, LADOT Transit operates 361 buses powered by compressed natural gas (CNG), Propane, Gasoline, and Electric. Table 1 presents a summary of LADOT Transit's existing bus fleet.

**TABLE 1
CURRENT LADOT TRANSIT FLEET INVENTORY**

Total Vehicles	Year Built	Manuf.	Model	Length	Type of Fuel	Bus Type
1	2003	El Dorado	E-Z Rider II	30 Ft.	Propane	Standard
19	2006	El Dorado	E-Z Rider II	30 Ft.	Propane	Standard
5	2007	El Dorado	E-Z Rider II	30 Ft.	Propane	Standard
24	2009	El Dorado	E-Z Rider II	30 Ft.	Propane	Standard
14	2011	El Dorado	Aerotech	22 Ft.	Gasoline	Cutaway
3	2011	Freightliner	Trolley	29 Ft.	Propane	Standard
2	2011	MCI	D4000	40 Ft.	CNG	Over-the-Road
14	2012	El Dorado	Axess	35 Ft.	CNG	Standard
22	2012	El Dorado	E-Z Rider II	32 Ft.	CNG	Standard
93	2012	MCI	D4000	40 Ft.	CNG	Over-the-Road
6	2013	El Dorado	Axess	35 Ft.	CNG	Standard
22	2013	El Dorado	E-Z Rider II	30 Ft.	Propane	Standard
54	2015	Gillig	BRT	35 Ft.	CNG	Standard
8	2016	El Dorado	Axess	35 Ft.	CNG	Standard
12	2016	El Dorado	E-Z Rider II	32 Ft.	CNG	Standard
9	2016	MCI	D4000	45 Ft.	CNG	Over-the-Road
4	2017	BYD	BYD	35 Ft.	Electric	Standard
10	2017	El Dorado	E-Z Rider II	32 Ft.	CNG	Standard
6	2017	MCI	D4500	45 Ft.	CNG	Over-the-Road
10	2018	Ford	Startrans	24 Ft.	CNG	Cutaway
5	2019	MCI	D4500	45 Ft.	CNG	Over-the-Road
20	2020	Ford	Startrans	24 Ft.	CNG	Cutaway

4.1.3 LADOT Future Bus Purchases

As of 2019, all of LADOT’s bus purchases must be BEBs to meet the City’s zero-emission mandate. LADOT Transit ordered 156 BEBs and the BEBs will be delivered in the next 12 months. This includes our standard buses and one over-the-road coach. We are waiting for the cutaway buses to meet the Federal Transit Administration (FTA) bus procurement requirements including Altoona safety testing and Buy America before we place an order for 14 cutaways. Table 2 details LADOT’s bus purchases for the next 10-years that will meet the City’s mandate of a 100% BEB fleet.

**TABLE 2
FUTURE LADOT BUS PURCHASES**

Year	Total Number of Buses to Purchase	Number of ZEB Buses	Percentage of ZEB Purchases	ZEB Bus Type	Zeb Fuel Type	Number of Conv. Buses	Percentage of Annual Conv. Bus Purchases
2020	24	24	100%	Standard	Electricity	0	0%
2020	131	131	100%	Standard	Electricity	0	0%
2021	1	1	100%	Over-the-Road	Electricity	0	0%
2022	27	27	100%	Standard	Electricity	0	0%
2022	14	14	100%	Cutaway	Electricity	0	0%
2022	22	22	100%	Standard	Electricity	0	0%
2023	22	22	100%	Standard	Electricity	0	0%
2024	14	14	100%	Standard	Electricity	0	0%
2024	95	95	100%	Over-the-Road	Electricity	0	0%
2025	9	9	100%	Standard	Electricity	0	0%
2026	10	10	100%	Cutaway	Electricity	0	0%
2026	12	12	100%	Standard	Electricity	0	0%
2027	64	64	100%	Standard	Electricity	0	0%
2027	20	20	100%	Cutaway	Electricity	0	0%
2028	9	9	100%	Over-the-Road	Electricity	0	0%
2028	8	8	100%	Standard	Electricity	0	0%
2029	6	6	100%	Over-the-Road	Electricity	0	0%
2030	4	4	100%	Standard	Electricity	0	0%

4.1.4 Range and Estimated Costs of Future BEB Purchase

Table 3 details the estimated costs of future BEB purchases. The estimated cost of purchasing LADOT’s BEBs over the next ten-years is over \$350 million. Today, the difference in the cost of a CNG-powered bus and a BEB is anywhere from 10% to 35%. If we take an average of 20% cost upcharge for a BEB than LADOT would need an additional \$70 million in gap funding to purchase the BEBs. Early adopters must have access to grant funding to cover the upcharge costs to transition to BEBs and meet the state’s ICT requirement. Once the cost of a BEB is on par with a CNG-powered bus then the need for upcharge gap funding would be eliminated.

**TABLE 3
RANGE AND ESTIMATED COSTS OF FUTURE ZEB
PURCHASES**

Year	Total Number of Buses to Purchase	Number of BEB Buses	ZEB Bus Type	Zeb Fuel Type	Required Range (miles)	Cost	Cost per Bus
2020	24	24	Standard	Electricity	110	\$750,000	\$18,000,000
2020	131	131	Standard	Electricity	110	\$650,000	\$85,150,000
2021	1	1	Over-the Road	Electricity	125	\$850,000	\$850,000
2022	27	27	Standard	Electricity	110	\$721,000	\$19,467,000
2022	14	14	Cutaway	Electricity	95	\$210,000	\$2,940,000
2022	22	22	Standard	Electricity	110	\$721,000	\$15,862,000
2023	22	22	Standard	Electricity	110	\$721,000	\$15,862,000
2024	14	14	Standard	Electricity	110	\$721,000	\$10,094,000
2024	95	95	Over-the Road	Electricity	125	\$950,000	\$90,250,000
2025	9	9	Standard	Electricity	110	\$721,000	\$6,489,000
2026	10	10	Cutaway	Electricity	95	\$210,000	\$2,100,000
2026	12	12	Standard	Electricity	110	\$721,000	\$8,652,000
2027	64	64	Standard	Electricity	110	\$721,000	\$46,144,000
2027	20	20	Cutaway	Electricity	95	\$210,000	\$4,200,000
2028	9	9	Over-the Road	Electricity	125	\$950,000	\$8,550,000
2028	8	8	Standard	Electricity	110	\$721,000	\$5,768,000
2029	6	6	Over-the Road	Electricity	125	\$950,000	\$5,700,000
2030	4	4	Standard	Electricity	110	\$721,000	\$2,884,000
TOTAL	492				TOTAL	\$12,219,000	\$348,962,000

4.1.5 BEB CONVERSIONS

LADOT Transit will not convert any of our conventional buses currently in service to zero-emission buses. LADOT will replace our conventional buses with BEBs.

**TABLE 4
SCHEDULE OF CONVERTING BUSES TO ZERO-EMISSION
BUSES**

Timeline	Number of Buses	Removed Propulsion System	New Propulsion System
None	None	None	None

5 SECTION E: FACILITIES AND INFRASTRUCTURE MODIFICATIONS

5.1 FULL BUS FACILITY ELECTRIFICATION IMPLEMENTATION PLAN

Full Bus Facility Electrification Analysis and Implementation Plan:

Final Report on Bus Facility Electrification Analysis and Planned Deployment Phases for LADOT Bus Yards
MAY 2020

Prepared by:
CALSTART



As part of a Federal Transit Administration Low or No Emission Grant, CALSTART prepared a *Full Bus Facility Electrification Analysis and Implementation Plan* for LADOT Transit’s three city-owned facilities. With LADOT Transit’s ambitious goal of a fully electric fleet by 2030, the need to determine the required infrastructure to power our new battery-electric bus fleet is critical. This electrification plan provides LADOT Transit a schedule to acquire and install the electrification infrastructure. This will include the enhancements and expansions of electrical equipment, additional electrical capacity, and the installation of BEB chargers, dispensers, and other components.

LADOT Transit selected overnight fast charging for all three yards based on existing service needs and site configurations. The proposed layouts are based on utilizing a 125 kW DC charging cabinet in a 1:2 charging orientation (one DC charging cabinet energizes two separate dispensers/buses). This charger to dispenser ratio would meet the requirements to charge LADOT Transit’s fleet overnight and minimize peak electrical demand.

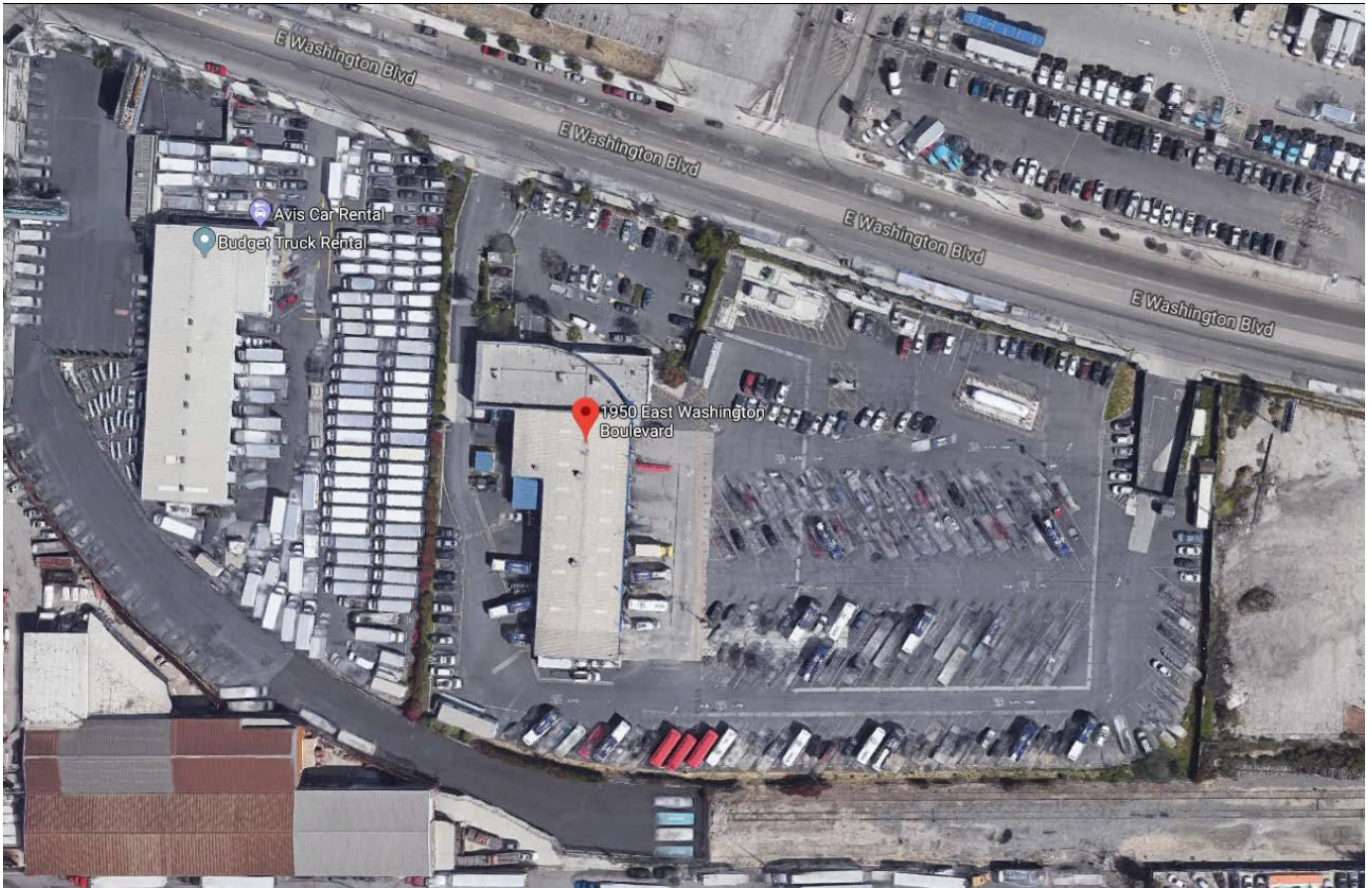
5.2 CURRENT FACILITY CONDITIONS

Below is a description of the current electrification infrastructure conditions of each of the three city-owned bus yards.

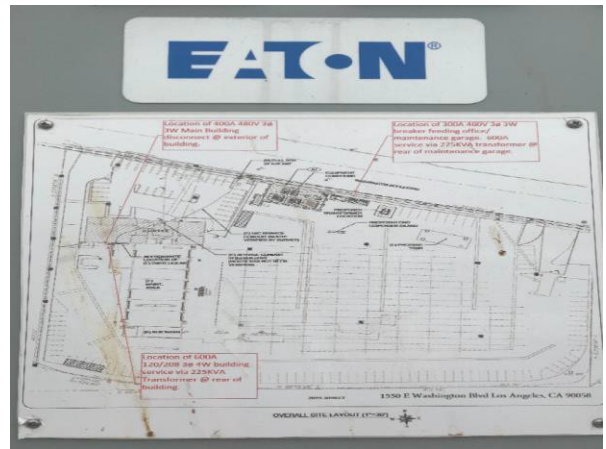
Washington Yard - 1950 E. Washington Blvd

The 1950 E. Washington Blvd. Bus Yard has one meter for the facility. The electrical supply is on the north side of the facility. The facility also has a 225 kVA transformer which is connected to a 1600 A, 480/277 V, main switchgear cabinet.

1950 East Washington Blvd. Site Map



LADWP Transformer and Main Switchgear

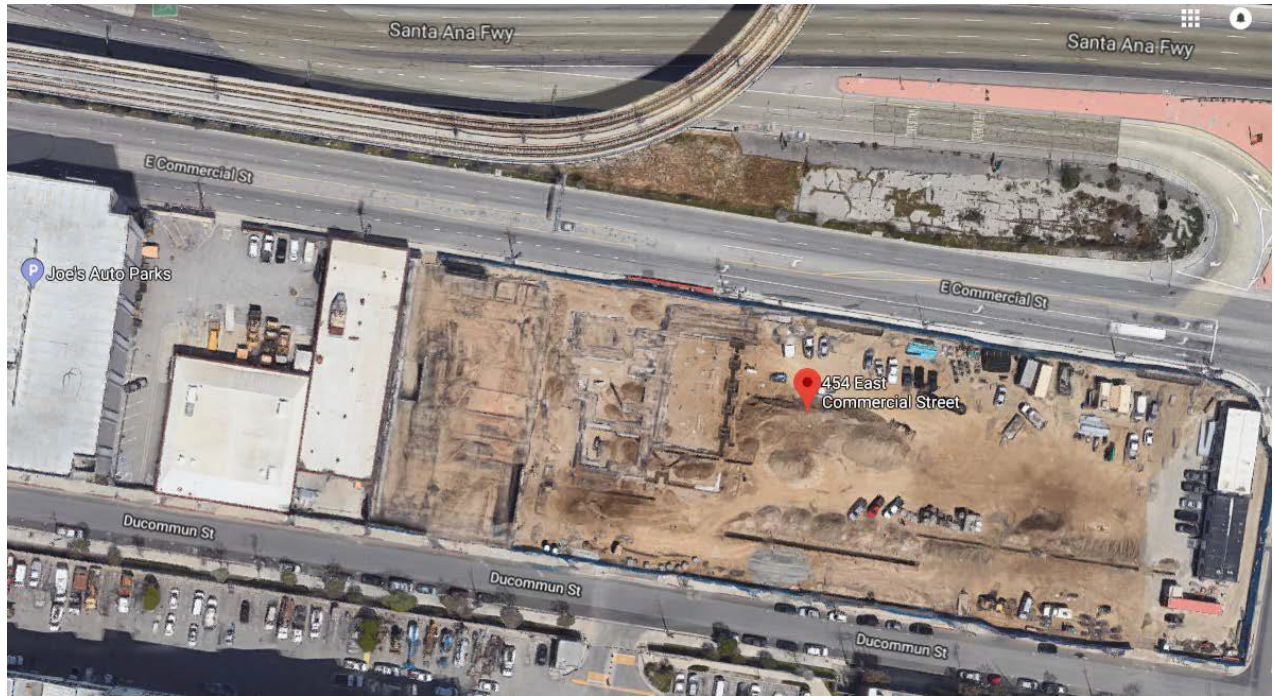


Map of 300 A Branch Circuit for Bldg.

Downtown Yard - 454-518 East Commercial Street

The 454-518 East Commercial Street Site has a transformer. It is attached to the main switchgear, which is rated 5000 A, 480/277 V and feeds a secondary 4000 A panel that feeds the CNG equipment and (26) 125 A fuses for EV circuits. The Downtown Yard is a newly constructed yard that included electrification infrastructure and conduit to allow for charging.

454-518 East Commercial Street Site Map



12' Bus Lane / Charger Conduit Stub-Up



4000 A EV / CNG and Pane



Sylmar Yard - 12776 Foothill Blvd

The 12776 Foothill Blvd. Bus Yard has multiple meters, a transformer, and switchgear on site. The switchgear was not marked, but located next to an LADWP transformer and CNG facility.

12776 Foothill Blvd Site Map



LADWP Transformer



Planned South Los Angeles All-Electric Yard

LADOT Transit is in the process of purchasing a property in South Los Angeles to construct a new all-electric bus yard. The yard is currently designed to operate 130 BEBs. This all-electric yard is needed to meet the City’s goal of 100% BEBs by 2030

5.3 FACILITY MODIFICATIONS

With three city-owned yards, LADOT Transit has an enormous task of preparing our yards to charge our new BEB fleet. As shown above, the yards are at different stages in terms of installing electrification infrastructure required to charge our BEBs. In addition, we are working with the Los Angeles Department of Water and Power to ensure access to the added electric power. The Table 5 below outlines the current facility modifications needed at each facility to charge the first batch of 156 BEBs that are scheduled to arrive in the next 12 months.

**TABLE 5
FACILITIES INFORMATION AND CONSTRUCTION TIMELINE**

Facility	Address	Main function	Types of Infrastructure	Service Capacity	Needs Upgrade	Estimated Construction Timeline
Downtown	540 E. Commercial St. Los Angeles, CA 90012	Maintenance, fueling, and overnight charging	Install additional 125kW chargers and additional infrastructure equipment	Fast charging to deploy 25 BEB in 2021.	Yes	In 2020, capacity of 25 electric buses. By 2027 parking rearranged and installation of 28 depot fast chargers (125kW) and installation of electrification infrastructure. The facility is expected to accommodate 82 BEBs.
Sylmar	12776 Foothill Blvd. Sylmar, 91342	Maintenance, fueling, and overnight charging	Construction to install infrastructure equipment (transformers, Switch gear cabinets etc.), install 125kW chargers	Fast charging to deploy 23 BEB in Q4 of 2021.	Yes	In 2021, capacity of 23 buses. In 2024 parking rearranged and installation of 47 depot fast chargers (150kW) and installation of electrification infrastructure. The facility is expected to accommodate 94 BEBs.
Washington	1950 E. Washington Blvd. Los Angeles, 90021	Maintenance, fueling and overnight charging	Construction to install infrastructure equipment (transformers, Switch gear cabinets etc.), install 150kW chargers	Fast charging to deploy 96 BEB in 2022.	Yes	In 2022, capacity of 96 buses. In 2025 parking rearranged and installation of 32 depot fast chargers (125kW) and installation of electrification infrastructure. The facility is expected to accommodate 150 BEBs.
<i>South Yard</i>	14011 S. Central Los Angeles 90059	Maintenance, fueling, and overnight charging	Construction of all-electric bus maintenance facility that includes the installation of infrastructure equipment (transformers, Switch gear cabinets etc.), install 125kW chargers	Fast charging to deploy 10 BEBs in 2021	Yes	In 2021 purchase land to build a new facility in South Los Angeles (previously leased). In 2022, begin the construction of an all-electric bus maintenance facility that includes the installation of 65 depot fast chargers (125kW). The facility is expected to accommodate 130 BEBs.

Finally, Table 6 shows that none of our facilities are located in NOx-Exempt Areas.

**TABLE 6
NO_x-EXEMPT AREA AND ELECTRICAL UTILITIES'
TERRITORIES**

Facility	Address	Type(s) of Bus Propulsion System	Located in NO _x Exempt Area?
Downtown	540 Commercial St. Los Angeles, CA 90012	CNG, Propane, battery-electric	No
Sylmar	12776 Foothill Blvd. Sylmar, 91342	CNG, Propane, battery-electric	No
Washington	1950 E. Washington Blvd. Los Angeles, 90021	CNG, Propane, battery-electric	No
<i>South Yard</i>	14011 S. Central Los Angeles 90059	Battery-Electric	No

6 SECTION F: DISADVANTAGED COMMUNITIES

DACs refer to the areas that suffer the most from a combination of economic, health, and environmental burdens. The CalEPA and California’s Senate Bill 535, define a “disadvantaged” community as a community that is located in the top 25th percentile of census tracts identified by the results of the California Communities Environmental Health Screening Tool (CalEnviroScreen).

CalEnviroScreen uses environmental, health, and socioeconomic data to measure each census tract (community) in California. Each tract is assigned a score to gauge a community’s pollution burden and socioeconomic vulnerability. A higher score indicates a more disadvantaged community, whereas a lower score indicates fewer disadvantages.

The replacement of conventional buses with ZEBs can yield many benefits in the communities they serve, including a reduction of noise and harmful pollutants. DACs are disproportionately exposed to these externalities, thus, should be prioritized and considered during initial deployments of ZEBs.

6.1 LADOT TRANSIT’S DISADVANTAGED COMMUNITY ANALYSIS

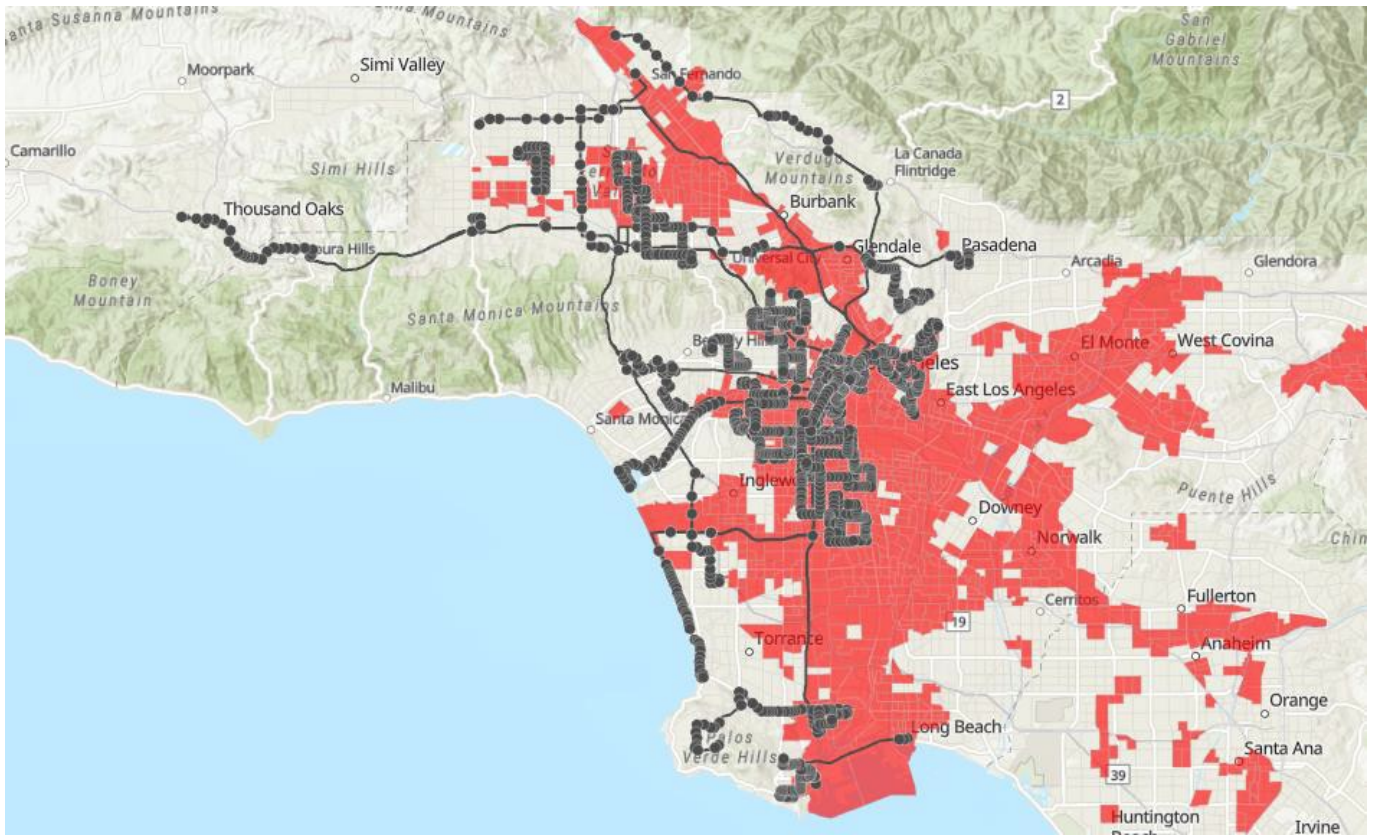
Many of the areas that LADOT serves are considered to be disadvantaged communities. LADOT operates DASH and Commuter Express bus services. The DASH program provides service to 31 communities across the City of Los Angeles. As a whole, 85% of DASH service operates in DACs. LADOT will also provide new DASH services to DACs within the San Fernando Valley, which is largely underserved by both DASH and rail services. LA Metro is also working to improve transportation in the San Fernando Valley with the East San Fernando Valley Transit Corridor project that will provide a light rail line by 2027. Several DASH routes will connect with the new service. Metro is also implementing the North San Fernando Valley BRT that will provide an east-west line in the north Mid-Valley to connect Cal State Northridge, which will open in 2025. DASH Northridge will connect to the new line.

The new and expanded services will serve a population of 747,936 residents who live in some of the poorest and most heavily polluted neighborhoods of Los Angeles. Los Angeles is in a severe non-attainment area on a national scale. 24.3% of the community members living within the project area live below the poverty level with the highest level of poverty at 42.4%. Based on CalEnviroScreen, of the 185 tracts that are served by LADOT DASH and Commuter Express services, 73% are located in the 25th percentile of highest levels of pollution throughout the state. The conversion to battery-electric buses will benefit a large number of DACs as it will eliminate the air pollution caused by even lower emission CNG buses, resulting in air quality benefits to the populace from the reduction of diseases caused by pollution. Disadvantaged communities like Watts, California, will benefit from having all buses on local routes being converted to battery-electric buses. The rollout of battery-electric buses was implemented in consultation with and with the support of the local community.

LADOT aims to deploy the zero-emission buses in disadvantaged communities to help improve air quality and provide health benefits to these areas. Many of LADOT’s current routes already serve disadvantaged communities with a high proportion of LADOT’s bus stops being located in these areas. The electric buses will be used to replace the CNG and propane buses that serve these routes. As a result, through normal route operation, the electric buses will be primarily operated in disadvantaged communities.

As the electric buses are delivered, they will be deployed at the Washington, Commercial Street, Foothill, and 111th Place bus yards, per the deployment schedule. Each yard is scheduled to receive a portion of each year’s bus deliveries. As a result, the electric buses will be deployed across LADOT’s service area in multiple disadvantaged communities.

LADOT Dash and Commuter Express Routes and CalEnviroScreen



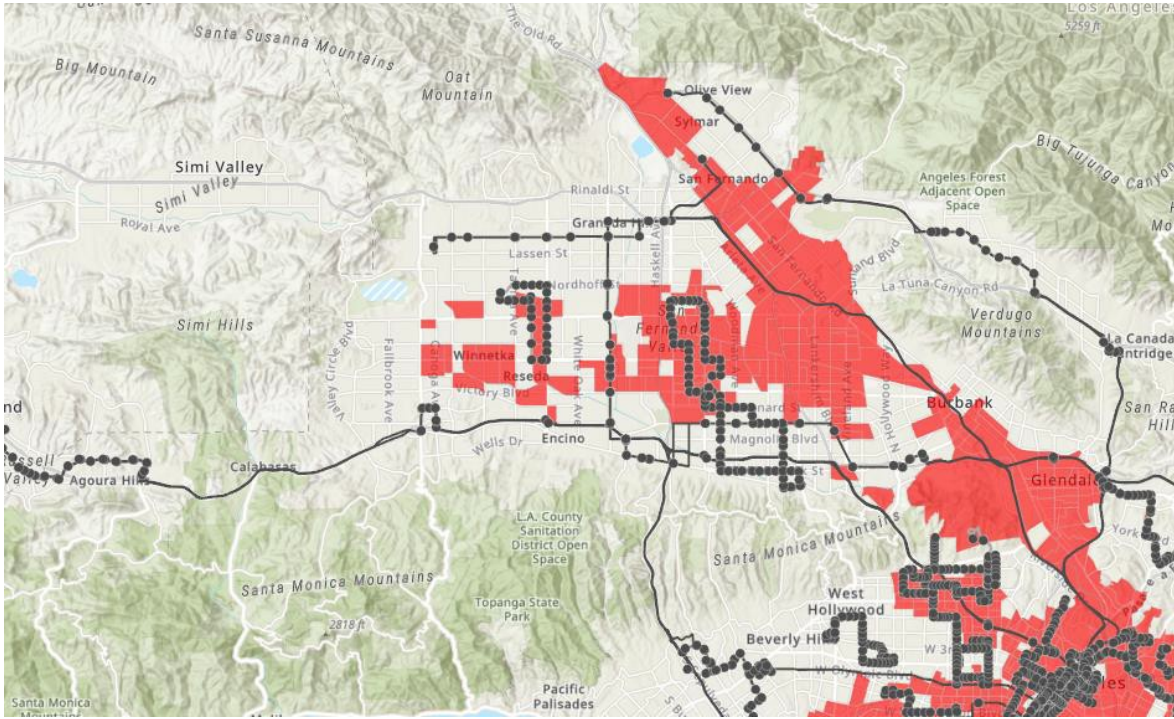
Lines represent LADOT routes; Dots represent LADOT stops

Source: CALSTART - Created with GIS data from the California Office of Environmental Health Hazard Assessment¹⁴ and the City of Los Angeles¹⁵

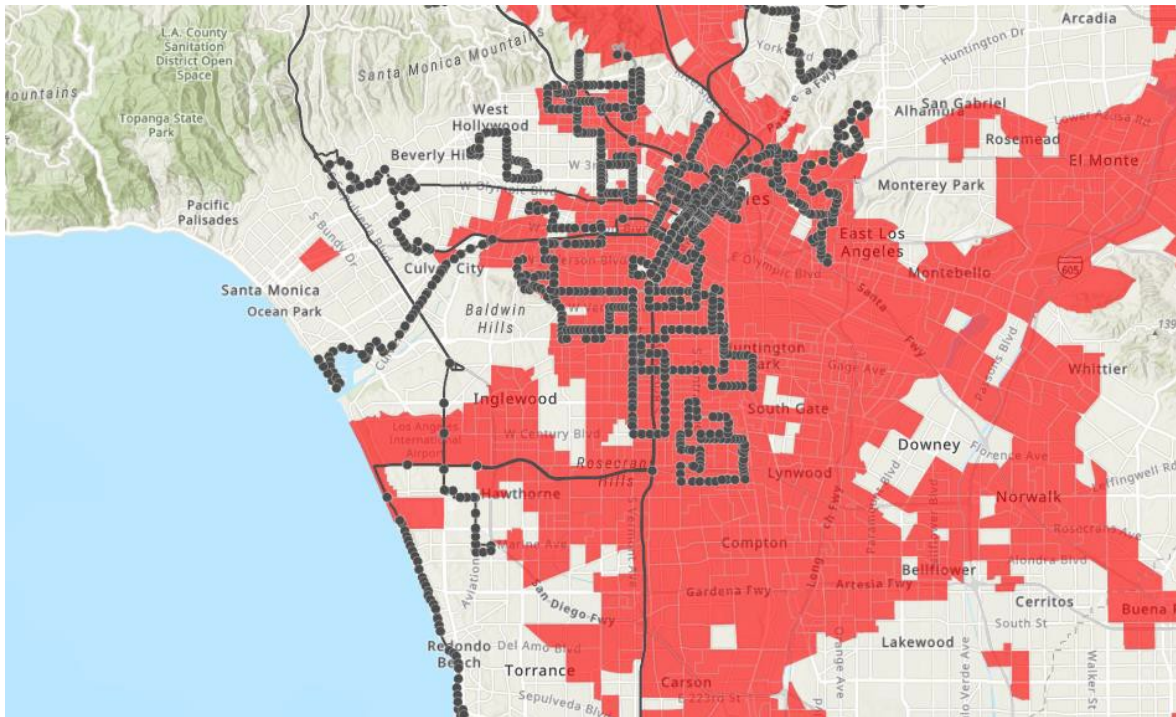
¹⁴ <https://oehha.ca.gov/calenviroscreen/sb535>

¹⁵ <https://catalog.data.gov/dataset/ladot-dash-and-commuter-express-routes-and-stops>

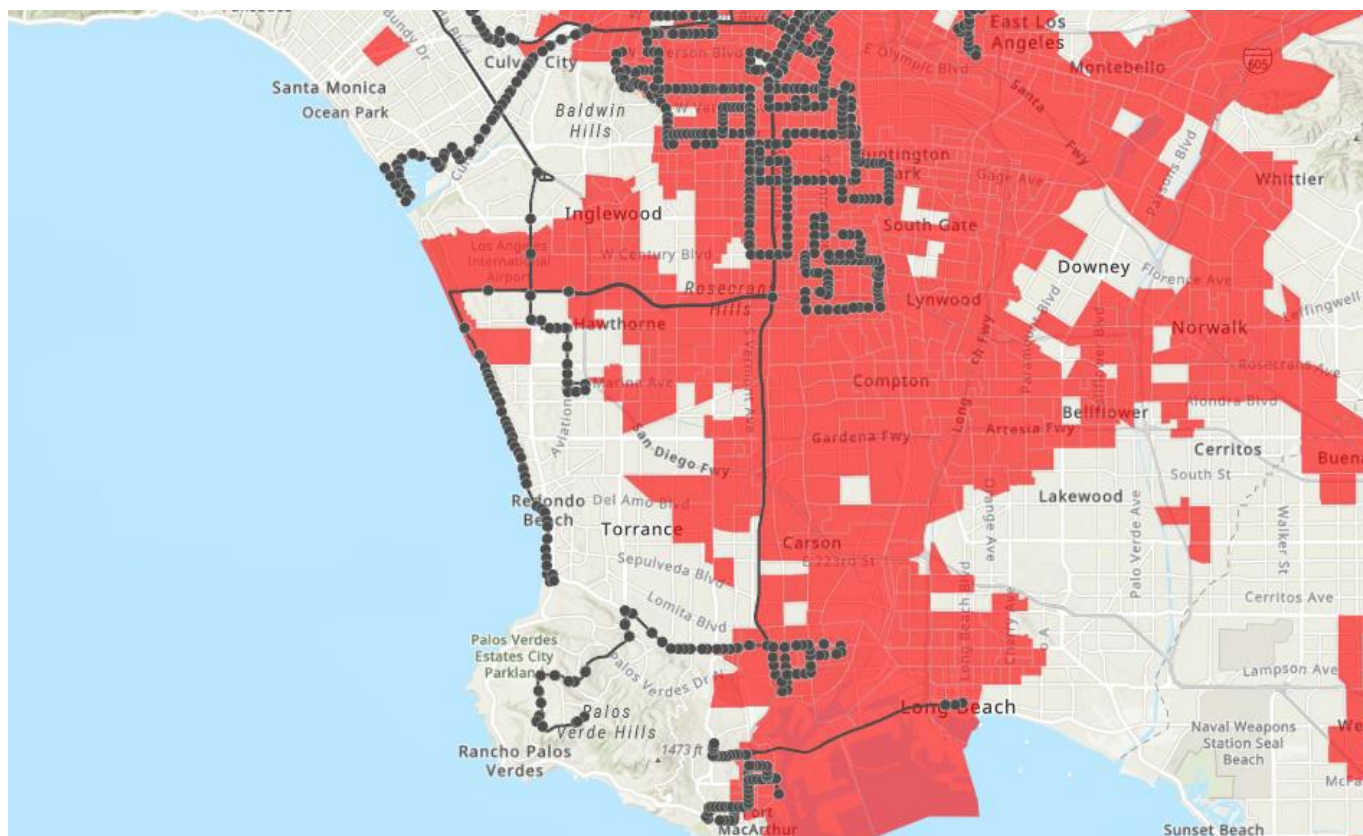
North Los Angeles LADOT Bus Routes and CalEnviroScreen



Downtown LA LADOT Bus Routes and CalEnviroScreen

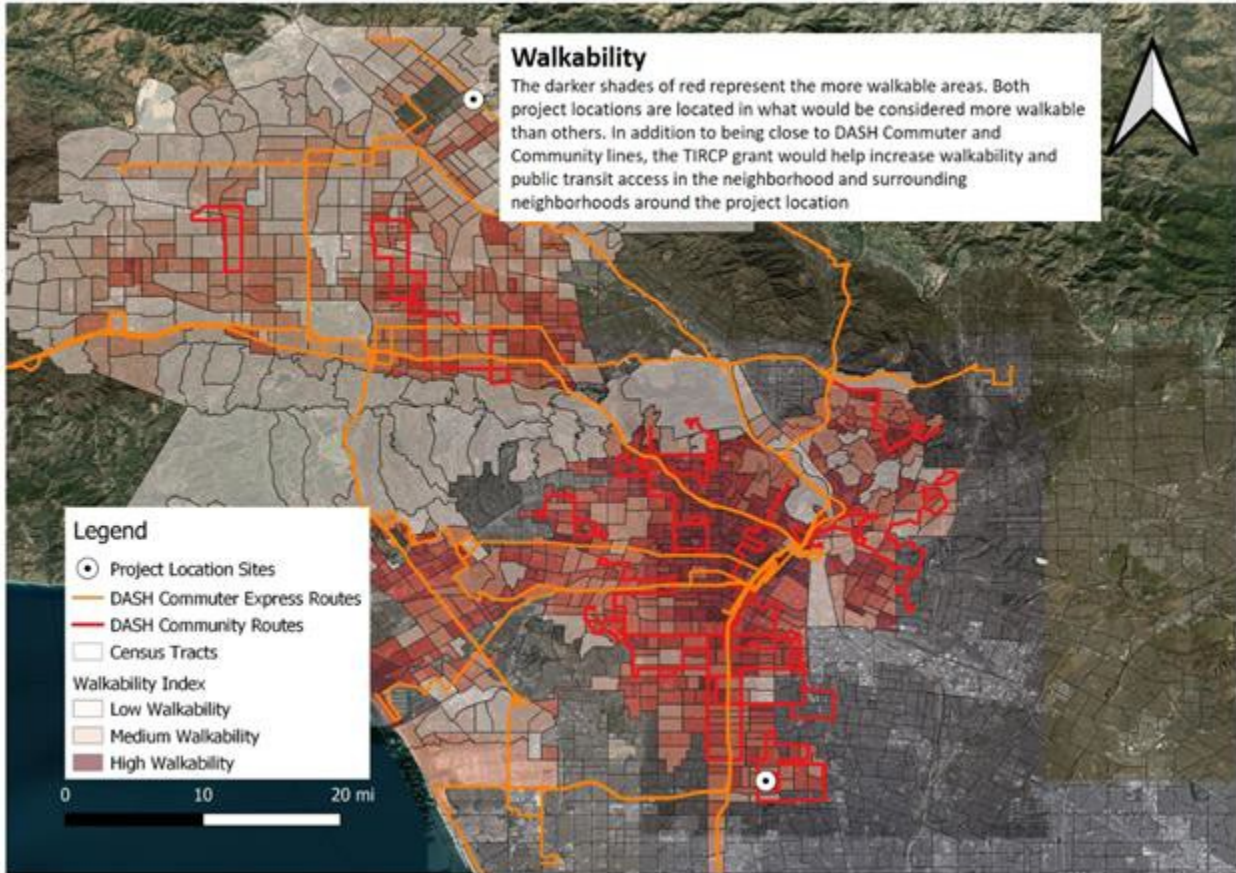


South LA LADOT Bus Routes and CalEnviroScreen



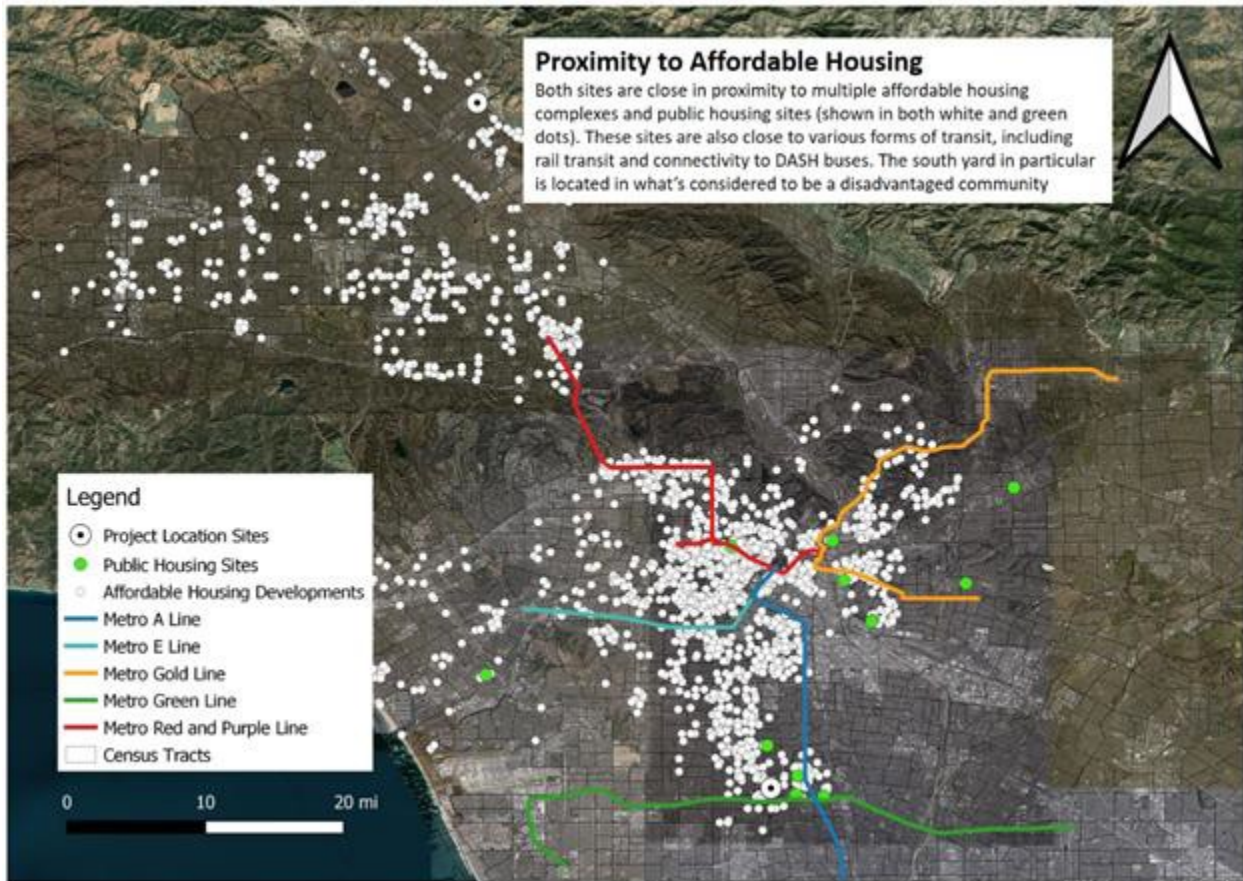
The buses also provide additional benefits to DACs beyond improving air quality. LADOT plans to serve disadvantaged communities by increasing their connectivity to other transit services and affordable housing. DASH routes operate primarily in areas that have high walkability scores. This benefits the community because it allows households without cars to access LADOT public transportation services. Many LADOT DASH and Commuter Routes are also close to affordable housing, which allows these residents to access these routes. LADOT is also integrating its routes with other forms of public transport. LADOT is the second-largest municipal operator in Los Angeles County. The principal transit provider in the City of Los Angeles is LA Metro. Metro operates multiple tiers of service ranging from local bus, Metro Rapid (BRT), Metro Light Rail, and Metro Subway. Understanding this regional transit network ultimately shapes the role that LADOT Transit can effectively play as a service provider. Metro BRT, Light Rail, and Subway lines are frequent, regional services that connect important destinations and activity centers. The services operate on linear corridors and help form the key spines in the transit network. LADOT Transit supports this network with DASH and Commuter Express services that complete gaps in local and regional mobility and provide community mobility and first/last mile connections. This improved connectivity opens up opportunities for Los Angeles residents to access jobs and schools. By increasing connectivity, LADOT hopes to reduce greenhouse gas emissions by increasing public transit ridership and reducing the need to drive personal vehicles.

Walkability Map and CalEnviroScreen



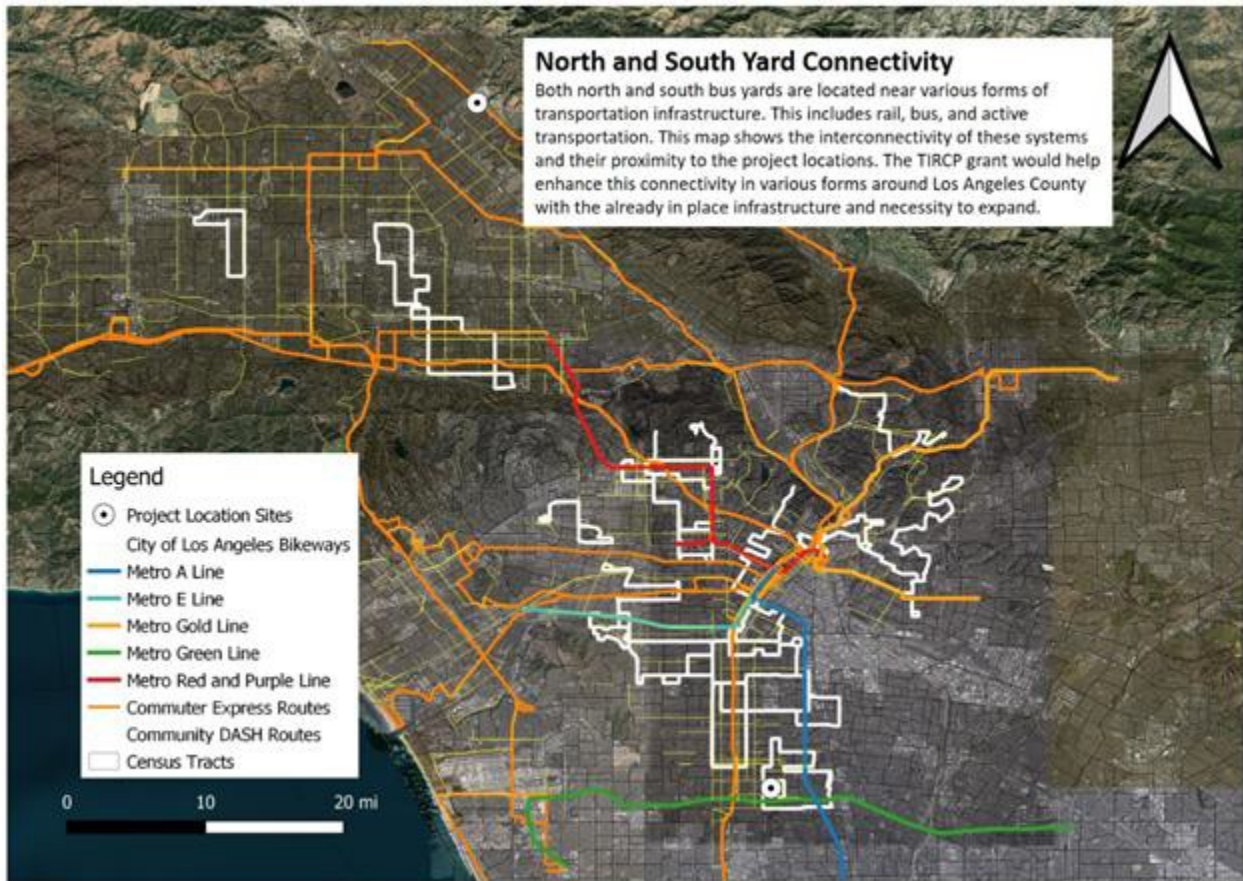
Current neighborhood walkability within the proximity of DASH and Commuter Express routes affected by the project.

Proximity to Affordable Housing Map to LADOT Transit Services



The above map shows proximity of affordable housing complexes and public housing sites to DASH routes.

North and South Yard Connectivity



The map above represents project transit routes and their connectivity to rail and active transportation infrastructure.

The deployment of electric buses will also provide the local community with economic and employment benefits. LADOT employs over 1,000 workers, many who live in disadvantaged communities in South Los Angeles. LADOT contracts with private service providers to operate and maintain our buses. All of the contractors are unionized and each operating facility belongs to a separate union. The union workers are vital to LADOT's operations. The City of Los Angeles prescribes a minimum living wage for our contracted employees but in most cases, this wage is exceeded. LADOT will be hiring drivers to meet their service demands. The new 740 East 111th Place bus depot will have a training room available for new hires.

7 SECTION G: WORKFORCE TRAINING

The following section provides an overview of LADOT Transit’s plan and schedule to train personnel on the impending transition.

7.1 TRAINING REQUIREMENTS

Zero emission buses have different maintenance needs and operation best practices than traditional internal combustion engine buses. BEBs replace the internal combustion engine with an electric drivetrain. The introduction of the electric drivetrain changes the maintenance needs of the bus. While maintaining a traditional bus, a maintenance technician needs to have expertise in maintaining and repairing internal combustion engines and moving parts like belts, alternators, and pumps. In addition, expertise in steering, HVAC, and suspension is valued. However, with BEBs, the vast majority of the moving parts are replaced with electric components, like batteries, DC-to-DC converters, and electric motors. As a result, the most vital skills for maintenance technicians to become proficient in are high voltage safety and proper use of personal protective equipment to minimize the risk of electrical shocks and arc flashes. Mechanics should consider obtaining the NFPA 70E: Standards for Electrical Safety in the Workplace and High Voltage OSHA 1910.269 8 Hour Qualified Training Course certificates. Local first responders need to receive training in electric vehicle safety so they can effectively respond in the event of an accident. Maintenance technicians will also need to become proficient in bus inspection, preventative maintenance, and how to handle removed battery systems to effectively maintain the buses. Mechanics will also need to learn how to troubleshoot basic bus charger problems.

Bus operators will also need training to drive the buses. BEBs need to be driven in a certain manner to optimize performance and bus range. Typically, electric buses maximize their range when they are accelerated slowly. Poor driver behavior, like rapidly accelerating from a stop, can reduce bus range by up to 25%. As a result, ensuring the bus operators drive the buses in the correct manner is vital to maximizing the benefits of the bus. “Range anxiety,” where the driver fears that they do not have enough charge to complete their route has also been widely documented. This has resulted in operators prematurely ending their route and returning to the depot to charge the bus. To avoid this problem, bus operators need to understand the range and capabilities of the bus. Bus operators also need to learn how to correctly use technologies like regenerative braking.

LADOT does not hire its own mechanics or bus operators. Instead, LADOT contracts with a company to provide mechanics and bus operators. The contractor is responsible for hiring and providing training to mechanics and bus operators. Since the contractor also serves other transit agencies, it is possible that some of the mechanics might have experience working on BEBs at other yards. LADOT’s contracts to procure BEBs stipulated that the OEM will provide service manuals and maintenance and bus operator training. The OEM-provided training begins about a week before the delivery of the buses. The OEM will send a field service representative to provide bus operator training to the contractor’s drivers. Since there are few moving parts on a zero-emission bus, the majority of the maintenance tasks relate to preventative maintenance. As a result, the field service representative provides safety, preventative maintenance, and diagnostic/troubleshooting training to the contractor’s mechanics. LADOT Transit also engages with the Southern California Regional Transit Training Consortium to train the mechanics. This organization works with the OEMs to provide train-the-trainer programs, including classroom and hands-on training. These programs focus primarily on safety and preventative maintenance. LADOT has already trained six mechanics through the Southern California Regional Transit Training Consortium. Since each mechanic is assigned to six buses, they currently have enough mechanics trained to work on the buses that will be deployed in 2020-21. More mechanics will be sent for training as the fleet scales up and additional buses are deployed.

The field service representative is also vital for training mechanics on more advanced maintenance tasks.

During the warranty period, if repairs or troubleshooting beyond preventative maintenance are needed, LADOT may call out the field service representative to fix the issue and teach the mechanics how to fix it. LADOT plans on using the warranty period to provide further training to its mechanics. If there are problems with any of the components on the bus, many component manufacturers offer similar services.

To adequately service the buses, LADOT will need to have proper tools and facilities. Many of the tools used to maintain traditional internal combustion engine buses can also be used to service electric buses. However, some specialized equipment is needed to handle electric vehicle high-voltage components like batteries, inverters, and traction motors. The following are examples of necessary tools and equipment:

- OEM-specific diagnostic tools to troubleshoot problems on the bus
- High impedance multimeters to monitor current in the electrical systems
- Insulated hand tools (wrenches, screwdrivers, pliers, etc.) to protect workers from shock
- Personal protective equipment including Class 0 rubber high voltage gloves (which need to be inspected and tested regularly), leather overgloves, insulated dielectric boots, face shield, insulating rubber apron, and insulated electrical rescue hook.
- Overhead crane to lift batteries from the roof of the bus
- Forklift to remove inverters and HVAC systems from the roof of the bus
- Scaffolding with fall protection so technicians can access the roof of the bus
- Lifting jigs for batteries and inverters
- OEM-specific tools to fix bus mechanical systems

8 SECTION H: POTENTIAL FUNDING SOURCES

8.1 PRELIMINARY CAPITAL COSTS

As expected, the cost of BEB adoption is going to be very expensive. It is assumed that a full transition for just BEBs not including the supporting charging infrastructure (based on existing conditions) will cost approximately \$348 million (in 2020 dollars). Due to the added cost of transitioning to BEBs, LADOT Transit must apply for grants to help offset the added costs.

8.2 POTENTIAL FUNDING SOURCES

The table below provides a number of potential local, state and federal funding sources available for BEBs and electrification infrastructure.

TABLE 7: BEB Funding Opportunities

TYPE	AGENCY	FUNDING MECHANISM
Federal	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	
TYPE	AGENCY	FUNDING MECHANISM
State	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
	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	
Local and Project-Specific		Affordable Housing and Sustainable Communities (AHSC)

8.3 EXISTING GRANT FUNDING FOR BEBS AND CHARGING INFRASTRUCTURE

Table 7 details LADOT Transit's grant funding sources for our 156 BEBs currently on order and an additional 27 standard BEBs and 14 cutaway BEBs that will be ordered shortly. Also included are the charging infrastructure grant funding for our three city-owned yards.

8.4 INNOVATIVE FINANCING MECHANISMS FOR BEBS AND CHARGING INFRASTRUCTURE

Emerging electric vehicle infrastructure companies have developed new financing mechanisms to support vehicle electrification. Many of these companies provide charging-as-a-service. Under the traditional financing model, transit agencies would need to finance the construction of infrastructure and pay a utility for the electricity they use to charge the bus. Under charging-as-a-service, a company will provide turn-key project management services for the construction and installation of infrastructure and the deployment of smart charging. The company then owns, operates, and maintains the infrastructure and the transit operator typically pays the company per kWh or per mile. Charging-as-a-service is an attractive option because it allows transit agencies to avoid the upfront capital expenditures required to install infrastructure, the need to win grants or issue bonds to fund infrastructure construction, utility demand charges, and the responsibility of maintaining infrastructure. It also provides the transit agency with more certainty for the operational costs of the fleet.

Amplify

Amplify is a charging-as-a-service company that offers smart charging services to fleets. Under their financing option, Amplify owns and operates the charging infrastructure and provides turn-key services to install and maintain the equipment and handle utility interconnection and upgrades. Amplify offers fixed rates for charging and guarantees the performance of the buses. It also uses software to minimize power demand and monitor the fleet in real-time. Amplify has a history of working with BYD and they recently launched a partnership to provide infrastructure and energy services to transit fleets.

Invenergy

Invenergy is an electric vehicle infrastructure company that offers a charging-as-a-service platform called Invenergy Edge. Invenergy Edge offers turn-key services to install and maintain the equipment and manage utility interconnection and upgrades. Invenergy Edge offers smart charging software to reduce peak demand and fleet monitoring to support maintenance and operations. Invenergy also offers

resiliency services and on-site and off-site renewables integration. Invenergy Edge has a flexible payment options, allowing customers to either own the project or finance the project via the charging-as-a-service platform.

In-Charge

In-Charge is a charging-as-a-service company that offers turn-key services to install and maintain electric bus charging infrastructure. In-Charge implements energy efficiency measures to reduce the load consumed by the current facility; designs, engineers, and builds out behind-the-meter charging infrastructure; operates and maintains the infrastructure; and deploys smart charging/energy management software to reduce peak demand. In-Charge also takes advantage of federal, state, and local tax incentives. In-Charge offers flexible financing options allowing the customer to pay per kWh, per mile, by the month, or for the entire project. In-Charge has formed a partnership with Ryder and ABB to provide turnkey electrification services to bus and truck fleets.

8.5 PROSPECTIVE FUNDING SOURCES FOR DISTRIBUTED ENERGY RESOURCES

Additional new funding sources that are on the horizon and that LADOT should consider are offered through the California Energy Commission, the State’s Infrastructure and Economic Development Bank (iBank), and new LCFS funding mechanisms. These opportunities are discussed in the following section.

California Energy Commission

The California Energy Commission (CEC) is poised to create two new funding sources for ZEB infrastructure in 2020. The first will be an ongoing infrastructure incentive program with an initial budget of \$50 million, which the CEC will create through a “block grant”, to be awarded to a non-profit program administrator. The chosen administrator will then design an incentive program for Medium and Heavy-Duty Vehicle (MHDV) charging infrastructure. CALSTART expects that this will be an ongoing program that receives additional funding every year, and it may cover up to 100% of the customer-side make-ready costs for MHDV charging. CALSTART’s estimate is that the \$50 million would fund chargers for close to 2,000 vehicles that are currently in, or will enter the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) queue in 2021 but which did not receive the prior HVIP “infrastructure plus up.”

The second new funding source from the CEC is expected to be a grant opportunity to fund infrastructure projects to support either conversion of an entire fleet to zero-emission or conversion of an entire bus depot to zero-emission. The CEC is proposing that \$20 million be available for these grants. We expect that these grants will only fund customer-side infrastructure, but potentially the CEC could include utility-side make-ready costs if the customer is served by a municipal utility that does not have an adopted MHDV make-ready program.

iBank

The state’s Infrastructure and Economic Development Bank (iBank) is poised to create a new low-interest loan program for public fleets. If the Governor’s proposal for a “Climate Catalyst Fund” is adopted, the state will begin offering low-interest loans to commercial fleets. Details of such a program have yet to be developed, but CALSTART understands this to be the goal from our discussions with the Governor’s Office of Business Development as well as the Director of the iBank, Scott Wu. These low interest loans could be used to fund vehicle purchases, as well as charging infrastructure projects.

LCFS

The Low Carbon Fuel Standard Program is administered by CARB and creates a mechanism for the users and producers of low-carbon fuels (including electricity) to generate credits for the use of these low-carbon fuels, which can then be sold in the LCFS market. This represents a significant revenue mechanism for commercial fleets in particular, who will earn LCFS credits worth, on average \$16,000 year (this number is likely higher for transit buses). CALSTART is working with CARB to determine whether a new LCFS incentive can be developed for fleets, equivalent to the “capacity credits” given to DC-FC and Hydrogen station developers. This LCFS program would provide fleets with up front credits equivalent to those that would be earned over a 5-8-year period of vehicle charging. These credits could be sold into the LCFS market, and the profits used to fund either vehicle purchases or charging infrastructure. CALSTART estimates that the capacity credit could have a value of \$80,000- \$128,000. This up-front credit could help with the needed capital for vehicles/ infrastructure, but would then reduce the LCFS credits earned over the lifetime of the vehicle/charger (because 5-8 years’ worth of credits would be provided up front).

9 SECTION I: START-UP AND SCALE-UP CHALLENGES

To comply with the ICT regulation's purchase and transition requirements, there are a number of challenges and opportunities that LADOT Transit has identified. The following sections briefly describe some of the challenges that LADOT Transit faces for its transition.

- **Continued State ZEB Grant Funding.** Adoption of BEBs has many benefits, including potential lifecycle cost savings. However, the investment required for capital and charging infrastructure is very expensive. The need of continued grant funding from the State of California is key to allow LADOT Transit to transition to BEBs by 2030.
- **Schedule Delays.** The time required to install charging infrastructure and the CEQA requirements for building a new all-electric bus maintenance facility are just a couple examples of long lead items that threaten to add years to our deployment schedules. Aid in adding all-electric bus maintenance facilities to CEQA categorical exemptions.

APPENDIX A: CITY OF LOS ANGELES BOARD RESOLUTION

RESOLUTION

ADOPTION OF LADOT TRANSIT'S ZERO-EMISSION BUS (ZEB) 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 2040.

WHEREAS, the ICT includes the following requirements for bus purchases for large agencies such as LADOT Transit:

- 25 percent of all new bus purchases must be ZE by January 1, 2023;
- 50 percent of all new bus purchases must be ZE by January 1, 2026;
- 100 percent of all new bus purchases must be ZE by January 1, 2029;
- 100 percent of fleet must be ZE by January 1, 2040; and
- Annual compliance reports must be submitted to CARB by March of every year from 2021 to 2050.

WHEREAS, the ICT regulation requires each agency to submit a ZEB Rollout Plan ("Rollout Plan") to CARB. The Rollout Plan is a living document intended to guide the agency's conversion to a ZEB fleet.

WHEREAS, the Rollout Plan must be approved by the transit agency's governing body through the adoption of a resolution prior to submission to CARB.

NOW, THEREFORE, BE IT RESOLVED that the City Council hereby adopts LADOT Transit's Zero-Emissions Bus Rollout Plan and approves it for submission to CARB.