SACRAMENTO REGIONAL TRANSIT DISTRICT

ZERO-EMISSION BUS ROLLOUT PLAN

FINAL

OCTOBER 2020

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1. ROLLOUT PLAN SUMMARY

AGENCY BACKGROUND

Transit Agency's Name	Sacramento Regional Transit District
Mailing Address	1400 29th St., Sacramento, CA 95816
Transit Agency's Air District	Sacramento Air Quality Management District
Transit Agency's Air Basin	Sacramento Valley Air Basin
Total number of buses in Annual Maximum Service[1]	189
Urbanized Area	Sacramento
Population of Urbanized Area[2]	1.1 Million
Contact information of general manager, chief operating officer, or equivalent	Henry Li | HLi@sacrt.com
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 full transition to ZE technology by 2040 that avoids early retirement of conventional transit buses?	Yes
Rollout Plan Development and Approval	
Rollout Plan's approval date	9/14/2020
Resolution No.	20-10-0117
Is copy of Board-approved resolution attached to the Rollout Plan?	Yes (Appendix A)
Contact for Rollout Plan follow-up questions	James Boyle, Director of Planning
Who created the Rollout Plan?	Consultant
Consultant	WSP

[1]The ICT regulation defines "Annual Maximum Service" (13 CCR § 2023(b)(3)) as the number of buses in revenue service that are operated during the peak season of the year, on the week and day that maximum service is provided but excludes demand response buses.

[2]As last published by the Census Bureau before December 31, 2017

[3]The ICT regulation defines a Joint ZEB Group or Joint Group (13 CCR § 2023.2) as two or more transit agencies that choose to form a group to comply collectively with the ZEB requirements of section 2023.1 of the ICT regulation.

2. INTRODUCTION

In accordance with the California Air Resource Board's Innovative Clean Transit regulation (CARB ICT regulation), the following report serves as Sacramento Regional Transit District (SacRT) Rollout Plan to transition its bus fleet to 100 percent zero-emission (ZE) by 2040.

2.1 BACKGROUND

2.1.1 CALIFORNIA AIR RESOURCE BOARD'S INNOVATIVE CLEAN TRANSIT REGULATION

The CARB's 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 of an agency's new bus purchases to be zero-emission buses (ZEBs) based on their 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 considered a living document and is meant to guide the implementation of ZEB fleets and help transit agencies work through many of the potential challenges and explore solutions. Each Rollout Plan must include a number of required components (as outlined in the Rollout Plan Guidelines) and must be approved by the transit agency's governing body through the adoption of a resolution, prior to submission to CARB.

According to the ICT regulation, each agency or Joint Group's requirements are based on its classification as either a "Large Transit Agency" or a "Small Transit Agency". The ICT defines a Large Transit Agency as an agency that operates in the South Coast or the San Joaquin Valley Air Basin and operates more than 65 buses in annual maximum service or it operates outside of these areas, but in an urbanized area with a population of at least 200,000 and has at least 100 buses in annual maximum service. A Small Transit Agency is an agency that doesn't meet the above criteria.

SacRT is categorized as a "Large Transit Agency" under the ICT regulation and must comply with the following requirements:

- July 1, 2020 – Board-approved Rollout Plan must be submitted to CARB.[4]
- January 1, 2023 – 25 percent of all new bus purchases must be ZE
- January 1, 2026 – 50 percent of all new bus purchases must be ZE
- January 1, 2029 – 100 percent of all new bus purchases must be ZE
- January 1, 2040 – 100 percent of fleet must be ZE
- March 2021 – March 2050 – Annual compliance report due to CARB

2.1.2 SACRAMENTO REGIONAL TRANSIT DISTRICT

SacRT operates 30 fixed routes, 19 commuter routes, 17 seasonal routes in addition to SmaRT Ride on-demand transit, Airport Express bus service, service to UC Davis, and 43 miles of light rail that covers a 400-square-mile service area. Buses and light rail operate 365 days a year using 97 light rail vehicles, 232 buses powered by compressed natural gas (CNG), 62 vans, 107 paratransit vehicles, and 15 electric shuttle buses.

Passenger amenities include 52 light rail stations, 30 bus and light rail transfer centers, and 22 park-and-ride lots. SacRT also serves over 3,100 bus stops throughout Sacramento County.

Annual ridership has fluctuated recently on both bus and light rail systems and has grown from 14 million passengers in 1987 to over 20.8 million passengers in FY 19. Weekday light rail and bus ridership averages approximately 37,500 and 35,000, respectively.

SacRT's SmaRT Ride on-demand transit provides smaller circulator buses to the communities of Arden, Carmichael, Citrus Heights, Downtown-Midtown-East Sacramento, Folsom, Franklin-South Sacramento, Gerber-Calvine, North Sacramento, and Rancho Cordova.

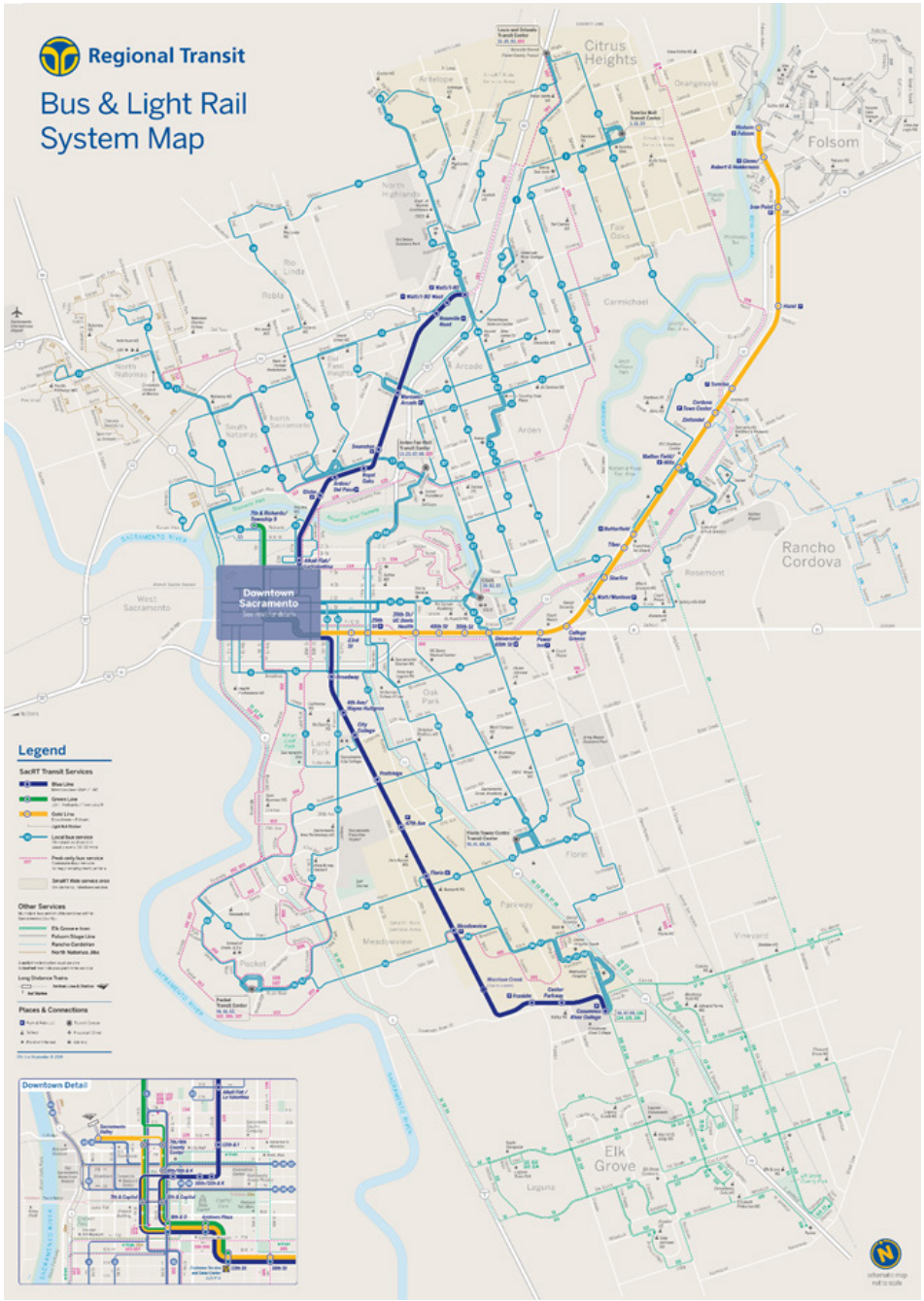
Airport Express bus service operates from Downtown Sacramento to the Sacramento International Airport every 20-30 minutes, seven days a week.
The Causeway Connection electric bus operates Monday through Friday from 5:30 a.m. to 8:50 p.m. between the cities of Davis and Sacramento.

SERVICE AREA

SacRT's service district covers nearly 400-square miles spanning the entirety of Sacramento County that includes the cities of Sacramento, Citrus Heights, Elk Grove, Folsom, and Rancho Cordova.

[4]Due to the impacts of COVID-19, CARB granted agencies an extension on their Rollout Plan upon request. SacRT requested an extension on May 29th that was granted on June 2nd.

Figure 2-1. SacRT Transit Map | Source: SacRT, September 2019



ENVIRONMENTAL FACTORS

Sacramento County is in California's Climate Zone 12. Sacramento's winter months average a low of 39 degrees, about average for the State. Its temperatures in the summer are typically hotter than the State average (approximately 93 and 87 degrees, respectively). An analysis of the elevation within 0.75 miles of SacRT's fixed-route service showed an average elevation of 102 ft., a low of -0.5 ft., and a high of 1,164 ft. The higher elevations of the service area are in the east in Folsom and most of the service area is under 100 ft. in elevation.

SCHEDULE AND OPERATIONS

SacRT's bus service includes Bus, Community Bus, and SmaRT Ride. Bus service includes fixed-route local and express service. Community Bus provides transit for residents and employees, SacRT offers this service in partnership with local agencies. SmaRT Ride is a microtransit service that is similar to other ride-share services where customers can use a smartphone application to request a ride within nine SacRT service areas.

SacRT operates 63 bus routes on weekdays and 26 on Saturday and Sunday. Service is primarily available between 5 a.m. to 11 p.m. every 12 to 60 minutes, depending on the route. Weekday bus ridership averages approximately 37,000 passengers per day. Fixed-route service operates out of two permanent and one temporary garage: Downtown Garage, McClellan Garage, and Hazel Station Garage.

2.2 EXISTING ZEB EFFORTS

2.2.1 PURCHASES AND PROCUREMENTS

SacRT is already a leader in the adoption and transition to ZEBs. As early as 2018, SacRT awarded a contract to GreenPower to provide six EV Stars for their award-winning SmaRT Ride microtransit service (all of which are now in service). In partnership with Electrify America (EA) and the City of Sacramento, SacRT purchased six Proterra 40' buses for Causeway Connection service and three for Airport service. These vehicles are currently in service. SacRT has also purchased nine Greenpower shuttles that are currently in use for the micro transit service.

2.2.2 ZERO-EMISSION BUS FACILITY TRANSITION STUDY

In 2019, SacRT partnered with WSP to produce the Zero-Emission Bus Facility Transition Study, a study to determine the feasibility of transitioning SacRT's existing fleet to ZEB. The study includes route and facilities analysis to develop preliminary plans and strategies to accomplish a 100% fleet transition to ZEBs. The initial findings of this study were used to inform the Rollout Plan. It should be noted that this study is still ongoing and will ultimately inform SacRT's next steps towards implementation.

2.3 ROLLOUT PLAN APPROACH

Pursuant to the ICT regulation, the Rollout Plan identifies a strategy for SacRT to procure and operate all ZEBs by 2040. Due to the rapidly-evolving nature of ZEB technologies, it is possible that the findings and recommended approaches in this report will be outdated when it is time for implementation. For that reason, a number of generous assumptions were included to account for technological advancements. For example, current BEB technology is not sufficient to meet the range requirements of all of SacRT's service blocks. To account for potential future improvements, the Rollout Plan assumes that battery technology will eventually meet the requirements of SacRT, therefore, a 1:1 (conventional bus to ZEB) replacement ratio was used to account for future ZEB bus procurements and facility enhancements. This approach ensures that SacRT is planning for the future and not conforming to or purchasing infrastructure that will only be compatible with existing technologies. To account for potential fleet increases, facilities are planned and designed for maximum build-out to ensure that enough ZEB infrastructure is in place for fleet expansion.

However, in some areas, SacRT is still evaluating technologies and strategies beyond 2030. Those areas of current study will be indicated, where applicable.

It should also be noted that this Rollout Plan is based on December 2019 data. This dataset is used because it represents the fleet in typical operations. Since then, COVID-19 has impacted SacRT's service, and future routes and plans may be impacted. SacRT has applied for and received an extension to the filing deadline for this plan to account for these changes.

The ***Start-Up and Scale-Up Challenges*** section identify the barriers that may prohibit or make these full-buildout scenarios difficult to achieve. These challenges will serve as the springboard for refinements and strategies in the next stages of implementation.

2.4 ROLLOUT PLAN PURPOSE AND STRUCTURE

In accordance with CARB's Rollout Plan Guidance, the District's Rollout Plan includes all required elements. The required elements and corresponding sections are detailed below:

- Transit Agency Information (Section 1: Rollout Plan Summary)
- Rollout Plan General Information (Section 1: Rollout Plan Summary)
- Current Bus Fleet Composition and Future Bus Purchases (Section 3: Fleet Acquisitions)
- Technology Portfolio (Section 3.2: ZEB Technology Application)
- Facilities and Infrastructure Modifications (Section 4: Facilities and Infrastructure Modifications)
- Providing Service in Disadvantaged Communities (Section 5: Disadvantaged Communities)
- Workforce Training (Section 6: Workforce Training)
- Potential Funding Sources (Section 7: Costs and Funding Opportunities)
- Start-up and Scale-up Challenges (Section 8: Start-up and Scale-up Challenges)

3. FLEET AND ACQUISITIONS

The following section provides an overview of SacRT's existing bus fleet, justification for ZEB technology, and a procurement schedule through 2040 that meets the CARB ICT regulation's requirements.

3.1 EXISTING BUS FLEET

The SacRT fleet includes CNG, diesel, gasoline, and battery-electric (BEB)-powered buses and shuttles. As of August 1, 2020, SacRT operates an active fleet of 197 40-foot buses and 181 paratransit shuttles that range from 25 to 32 feet in length. SacRT's fleet is operated from three "garages" – Downtown, McClellan, and Hazel. Table 3-1 provides a detailed overview of SacRT's fixed route bus fleet.

MANUFACTURER	SERIES	FUEL TYPE	LENGTH	IN SERVICE YEAR	BUS TYPE	NO. OF BUSES
Orion	2601-2605	CNG	40′	2006	Standard	5[5]
	2801-2901			2008		90
Gillig	1501-1596	CNG	40′	2015	Standard	30
				2016		66
El Dorado	1612-1616	Diesel	32′	2016	Standard	5
Proterra	1910-1915	BEB	40′	2019	Standard	6
					Total Buses	**202**

Table 3-1 Summary of SacRT's Existing | Source: SacRT, August 1, 2020

In addition to fixed route service, SacRT also operates Community Bus Service, SacRT GO, which is a paratransit partnership with local community neighborhoods and businesses, and ETran, a service for the neighboring City of Elk Grove. These services are exclusively operated with shuttle buses/cutaways that are not subject to the CARB ICT regulation.

3.2 ZEB TECHNOLOGY APPLICATION

Previous and ongoing SacRT ZEB analysis has found that BEBs are more suitable than fuel cell electric buses (FCEBS) for SacRT's existing operations. This is based on BEBs' rate of technological advancement, costs, and availability. Electricity is a reliable and readily-available fuel source and a variety of OEMs have entered the market and produced BEB models that are currently entering pilot or service phases around the country.

While FCEB technology is promising and has many potential benefits (as compared to both CNG and BEB), buses that serve SacRT's main bus division are stored under a freeway, where, according to fire safety regulations, hydrogen fuel storage is prohibited. Additionally, hydrogen fuel is more expensive than both electricity and natural gas and is currently a limited and potentially inconsistent resource. Furthermore, SacRT's facilities are space-constrained, a hydrogen solution could potentially require substantial footprints that are not currently feasible.

However, SacRT will continue to explore options to resolve space constraints. In doing so, as FCEBs become more affordable, SacRT will consider integrating them in the fleet (as indicated in Table 3-2).

3.2.1 BATTERY-ELECTRIC BUS TECHNOLOGIES

As mentioned, based on SacRT's conditions and service needs at this time, it is recommended that a ground mounted plug-in charging strategy be implemented to support BEBs at all three garages. SacRT's future BEBs are expected to have specifications that are compatible with the Society of Automotive Engineers' (SAE) J1772 (plug-in) charging standards. In the future, depending on available space, SacRT may consider overhead pantograph or ground-mounted inductive charging.

The proposed facility layouts for each garage are based on utilizing a 150-kW DC charging cabinet in a 1:2 charging orientation (one DC charging cabinet energizes two separate dispensers/buses). This charger to dispenser ratio maximizes space utility, reduces infrastructure costs, and meets the requirements to charge the fleet during servicing and dwell time on the site while minimizing the peak electrical demand.

Figure 3-1 shows an example of a ground-mounted plug-in charging bus yard.

Figure 3-1. A Plug-in Charging Yard | Source: WSP

[5] These five buses are used for training purposes only.

Table 3-2. Summary of SacRT's Future Bus Purchases (through 2040) | Source: WSP | Note: BEBs assumed to be replaced after 12 years in service.

		ZERO-EMISSION BUSES				CONVENTIONAL BUSES			
YEAR	TOTAL BUSES	NO.	PCT.	BUS TYPE	FUEL TYPE	NO.	PCT.	BUS TYPE	FUEL TYPE
2020	-	-	-	-	-	-	-	-	-
2021	-	-	-	-	-	-	-	-	-
2022	70	0	0%	-	-	70	100%	40′	CNG
2023	**25**	**7**	**25%**	**40′**	**BEB**	**18**	**75%**	**40′**	**CNG**
2024	-	-	-	-	-	-	-	-	-
2025	-	-	-	-	-	-	-	-	-
2026	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
2027	30	15	50%	40′	BEB/ FCEB	15	50%	40′	CNG
2028	70	35	50%	40′	BEB/ FCEB	35	50%	40′	CNG
2029	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
2030	-	-	-	-	-	-	-	-	-
2031	6	6	100%	40′	BEB/ FCEB	-	-	-	-
2032	-	-	-	-	-	-	-	-	-
2033	-	-	-	-	-	-	-	-	-
2034	70	70	100%	40′	BEB/ FCEB	-	-	-	-
2035	-	-	-	-	-	-	-	-	-
2036	-	-	-	-	-	-	-	-	-
2037	25	25	100%	40′	BEB/ FCEB	-	-	-	-
2038	-	-	-	-	-	-	-	-	-
2039	15	15	100%	40′	BEB/ FCEB	-	-	-	-
2040	50	50	100%	40′	BEB/ FCEB	-	-	-	-

3.3 PROCUREMENT SCHEDULE

In accordance with the ICT regulation, SacRT will prioritize ZEB purchases and progressively increase the percentage of ZEB purchases over time. Based on initial analysis, the last conventional bus (CNG) is expected to be purchased in 2028.

Early retirement should not be an issue pursuant to the ICT regulation (2040) based on SacRT's future purchases. One potential strategy is to place newly acquired buses on SacRT's longest (distance) blocks. This will ensure that these buses meet the Federal Transit Administration's (FTA) 500,000-mile requirement ("useful life") more rapidly.

Table 3-2 presents a summary of SacRT's anticipated bus procurements through 2040 (based on a 12-year replacement cycle). Years 2023, 2026, and 2029 are highlighted because these indicate when SacRT's new purchases should be 25 percent, 50 percent, and 100 percent ZEB, respectively. Figure 3-2 illustrates the fleet mix of conventional and ZEBs through 2040.

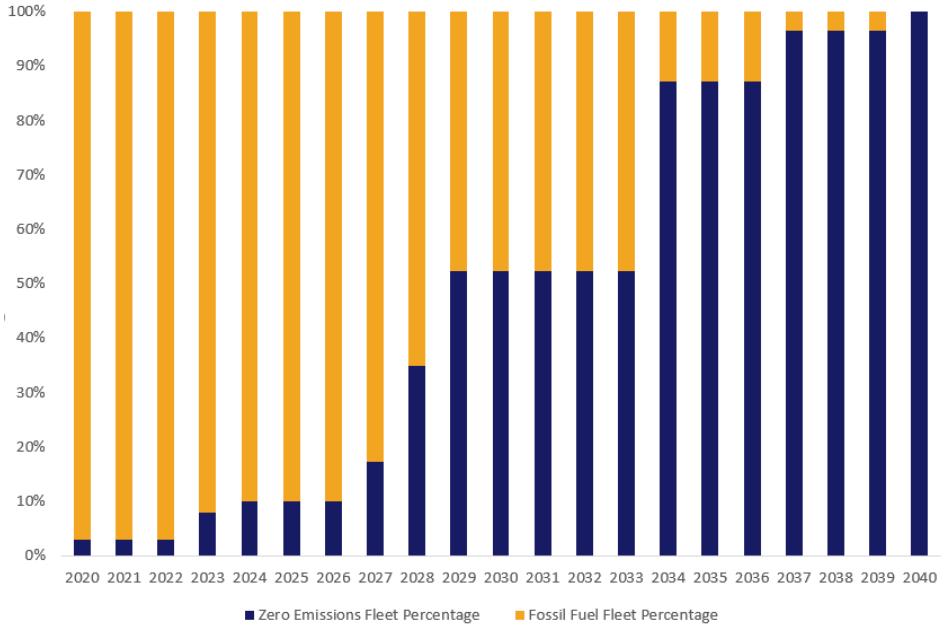


Figure 3-2. ZEB Fleet Percentage 2020 - 2040 | Source: WSP

3.3.1 ZEB CONVERSIONS

Conventional bus conversions to ZEB technologies are not currently being considered at this time. However, SacRT will remain open to conversions if they are deemed financially feasible and align with ZEB adoption goals.

4. FACILITIES AND INFRASTRUCTURE MODIFICATIONS

The following section details the planned charging strategies, infrastructure, detailed garage improvements, and construction and phasing schedule.

4.1 METHODOLOGY

Since ZEB technology continues to evolve, it is difficult to commit to a costly strategy that may become outdated or obsolete in the future. However, it is also pertinent to ensure that strategies are future-ready. For this reason, the recommended facility and infrastructure modifications are based on what can physically be accommodated at each garage. This provides SacRT with a ceiling for what can physically be constructed and worst-case scenario for electric utility planning. Since service changes and bus movements may occur multiple times a year, by establishing a full-build scenario, SacRT can optimize, and tailor strategies based on existing (or anticipated) service.

4.2 FACILITY MODIFICATIONS

SacRT's transition to a BEB fleet will require a number of modifications and changes to existing infrastructure and operations. This will include the enhancements and expansions of electrical equipment, additional electrical capacity, and the installation of chargers, dispensers, and other components. These modifications will occur at all three of SacRT's garages, and, if viable and required, at layover facilities for on-route charging operations.

During preliminary concept discussions, the feasibility of both conductive (overhead inverted pantographs, and ground-mounted or overhead plug-in) and inductive (in-ground wireless) charging dispensers were analyzed based on efficacy, costs, and spatial requirements. Due to spatial constraints, it was found that ground-mounted plug-in chargers are the most viable, at this time.

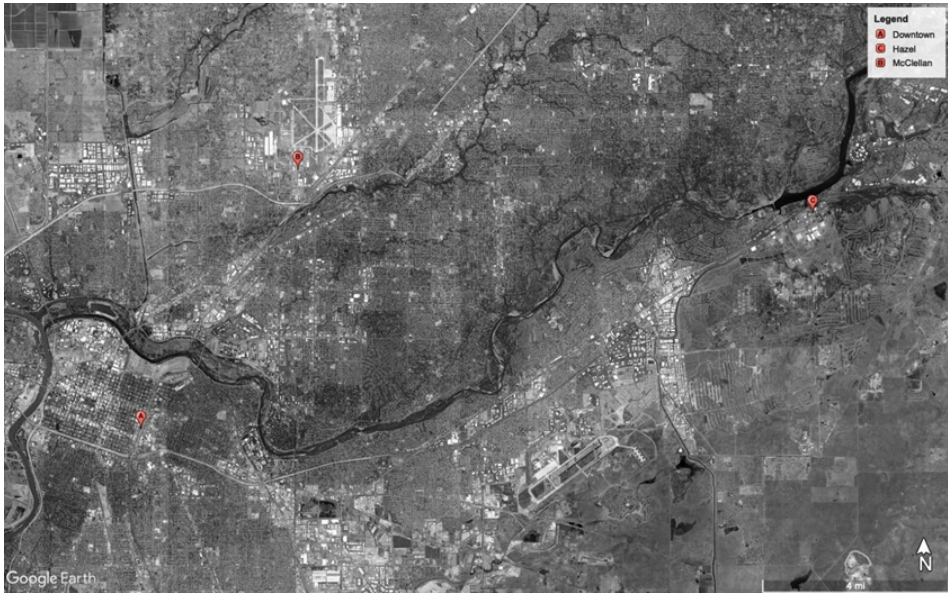
Proposed layouts are based on utilizing a 150-kW DC charging cabinet in a 1:2 charging orientation (one DC charging cabinet energizes two separate dispensers/buses). This charger to dispenser ratio would meet the requirements to charge SacRT's fleet overnight and minimize peak electrical demand.

As previously mentioned, the proposed facilities and modifications are based on what is feasible under existing conditions. If conditions change, SacRT will reanalyze the ZEB strategy to possibly include FCEBs and supporting infrastructure.

Figure 4-1 illustrates the location of SacRT's garages and Table 4-1 summarizes the modifications and schedule of each garage.

The following sections detail the process of each garage's transition from existing conditions to BEB-readiness.

Figure 4-1. SacRT's Garage Locations | Source: WSP; Google Earth



GARAGE	ADDRESS	MAIN FUNCTIONS	PLANNED INFRASTRUCTURE	SERVICE CAPACITY	UPGRADE REQ'D?	TIMELINES
Downtown	1323 28th St Sacramento, CA	Parking/ Storage	Plug-in Charging	146	Yes	2022-2035
McClellan	3701 Dudley Ave. McClellan, CA	O&M	Plug-In Charging	23+	Yes	2022-2035
Hazel	12500 Folsom Blvd. Rancho Cordova, CA	Parking/ Storage	Plug-In Charging	5+	Yes	2022-2035

Table 4-1. SacRT's Garage Summary | Source: WSP

Note: The construction timeline represents the span of time that each garage will be upgraded. Ongoing analysis will determine specific timelines and milestones.

4.2.1 DOWNTOWN GARAGE

EXISTING CONDITIONS

SacRT's Downtown Garage is split over multiple blocks in Sacramento. Buses are stored under the Capitol City Freeway between Q Street and Capitol Avenue with electrical utility service provided by the Sacramento Municipal Utility District (SMUD). The Downtown Garage's fuel, wash, and maintenance facilities are located at 1323 28th St adjacent to the storage area. Currently, 196 CNG 40-foot buses are stored, maintained, fueled, and serviced at the downtown garage.

Figure 4-2 presents Downtown Garage under existing conditions.

Figure 4-2. Downtown Garage (Bus Storage) - Existing Conditions | Source: WSP

PLANNED ZEB MODIFICATIONS

It is recommended that the Downtown Garage adopts a ground-mounted plug-in charging solution. The associated charging, switchgear, and transformer cabinets will be arranged within the parking area as space allows. Due to Caltrans' setback requirements, BEB-supporting infrastructure cannot be placed within 20 feet of the freeway's supporting columns. For this reason, the Downtown Garage can only accommodate 146 buses (net loss of 51 buses from existing) with 146 charging positions in a 1:2 charger to bus dispenser ratio. SacRT is currently assessing where these 51 buses will be relocated to.

Table 4-2 summarizes the ZEB infrastructure planned at Downtown Garage.

GARAGE	CHARGING STRATEGY	NO. OF EXISTING BUSES	NO. OF BUSES SUPPORTED	NO. OF CHARGERS	NO. OF DISPENSERS	CHARGER RATING
Downtown	Ground-mounted plug-in	197	146	73	146	150 kW

Table 4-2. Downtown Garage Supporting Infrastructure Summary | Source: WSP

The following BEB equipment is proposed:

- 73 DC charging cabinets located at the end of bus parking rows that will distribute to 146 plug-in charging positions spaced every two buses.
- Four standalone switchboards rated at 4000 Amps, 480V.
- Four transformers rated at 3,000 kV

Figure 4-3 illustrates the Downtown Garage at full build-out.

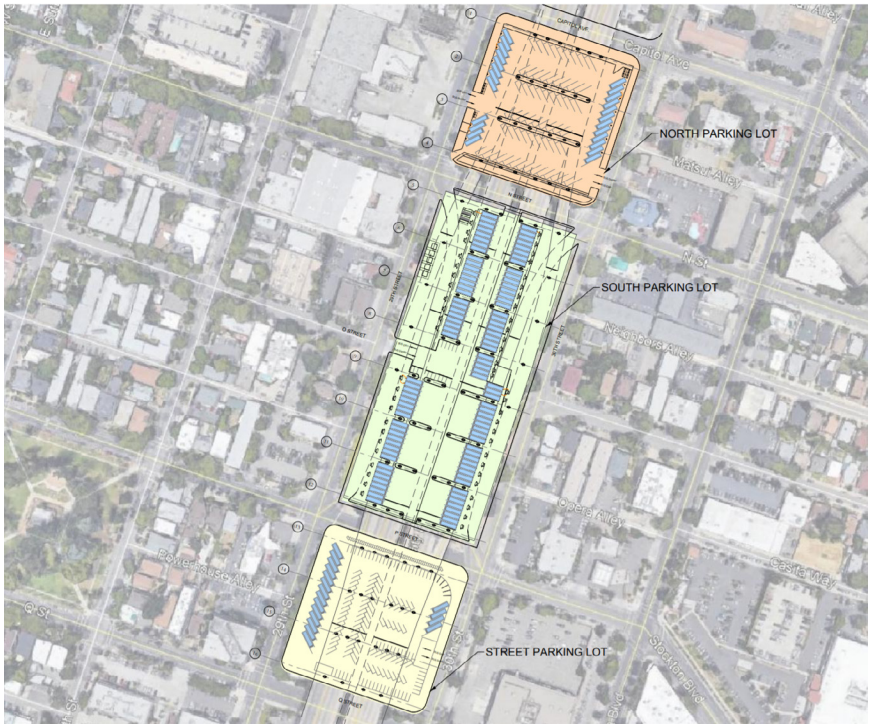


Figure 4-3 Downtown Garage - Full Build-Out | Source: WSP

4.2.2 MCCLELLAN GARAGE

EXISTING CONDITIONS

The McClellan Garage is located at 3701 Dudley Avenue in McClellan, CA. It is currently used to store, service and operate 23 gasoline-powered cutaway shuttles. The site includes a single-story maintenance building, and a combined fuel and wash building. Figure 4-4 presents McClellan Garage under existing conditions.

Figure 4-4 McClellan Garage - Existing Conditions | Source: WSP

PLANNED ZEB MODIFICATIONS

It is recommended that the McClellan garage adopt a ground-mounted plug-in charging solution. The associated charging, switchgears, and transformer cabinets will also be mounted on platforms adjacent to dispensers. The future ZEB infrastructure for this site is currently study, but it has the potential to store and charge over 80 buses.

Table 4-3 summarizes the ZEB infrastructure planned at McClellan Garage.

GARAGE	CHARGING STRATEGY	NO. OF EXISTING BUSES	NO. OF BUSES SUPPORTED	NO. OF CHARGERS	NO. OF DISPENSERS	CHARGER RATING
McClellan	Ground-mounted plug-in	23	23+	12+	23+	150 kW

Table 4-3. McClellan Garage Supporting Infrastructure Summary | Source: WSP

4.2.3 HAZEL GARAGE

EXISTING CONDITIONS

The Hazel Garage is located at 12500 Folsom Boulevard in Rancho Cordova, CA. It is used to store, service, and operate five diesel-powered 32-foot buses.

Figure 4-5 presents Hazel Garage under existing conditions.

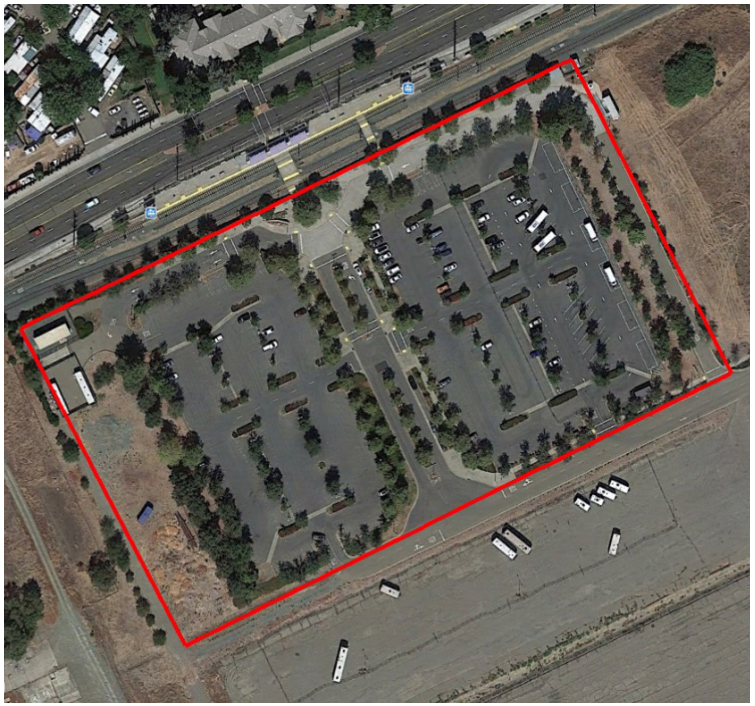


Figure 4-5 Hazel Garage - Existing Conditions

PLANNED ZEB MODIFICATIONS

Hazel Garage will likely adopt a ground mounted plug-in charging strategy. The associated charging cabinets, switchgears, and transformers will be located adjacent to the charging area. Charging type, future site layout, and utility connection are currently under study.

Table 4-4 summarizes the ZEB infrastructure planned at Hazel Garage.

GARAGE	CHARGING STRATEGY	NO. OF EXISTING BUSES	NO. OF BUSES SUPPORTED	NO. OF CHARGERS	NO. OF DISPENSERS	CHARGER RATING
Hazel	Ground-mounted plug-in	5	5+	3+	5+	150 kW

Table 4-4. Hazel Supporting Infrastructure Summary | Source: WSP

4.3 PHASING AND CONSTRUCTION STRATEGY

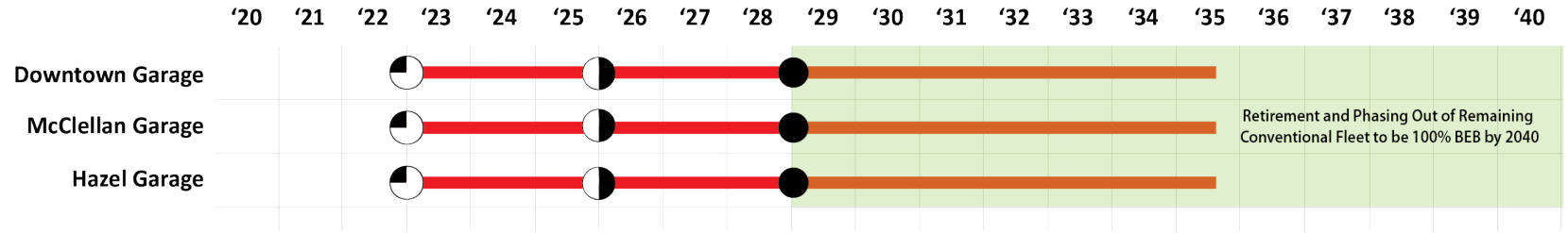
The process of integrating BEBs into SacRT's fleet will broken down into a number of important tasks and phases related to construction of supporting facilities. The assumed approach is a design-bid-build strategy. Multiple requests for proposals (RFPs) need to be developed and put out for bid, with accompanying design and construction activities taking place. Utility upgrades, onsite (phased) construction, and other activities are expected to last approximately five years, for each garage. This five-year assumption is a conservative estimate based on the amount of time it may take the utility to provide upgraded electrical equipment outside of the garage. The onsite upgrades and construction of BEB supporting infrastructure can be done concurrently.

To minimize or avoid operational or service impacts, it is recommended that onsite construction be implemented in phases. This method essentially segments the garage and ensures that construction continues without impacting SacRT's service.

Since BEBs cannot be operated unless infrastructure is in place to energize them, it is pertinent to meet construction deadlines because it has the ability to impact both service and ICT regulation compliance. It is assumed that buses can be procured 18 months before the conclusion of the facilities construction.

Figure 4-7 presents a conceptual schedule for SacRT's fleet transition. The Harvey Balls indicate the percentage of newly purchased that have to be ZEB. Note, the phasing and specific construction schedules are still being analyzed, however, it is anticipated that construction for each garage will be completed during this time frame (2022-2035).

Figure 4-6. Potential Phasing and Construction Schedule | Source: WSP



5. DISADVANTAGED COMMUNITIES

Disadvantaged communities (DACs) refer to the areas that suffer the most from a combination of economic, health, and environmental burdens. The California Environmental Protection Agency (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. In phasing and deployment, SacRT will ensure that DACs and equity are a driving factor in determining which garages and routes are first served with ZEBs.

5.1 DISADVANTAGED COMMUNITY ANALYSIS

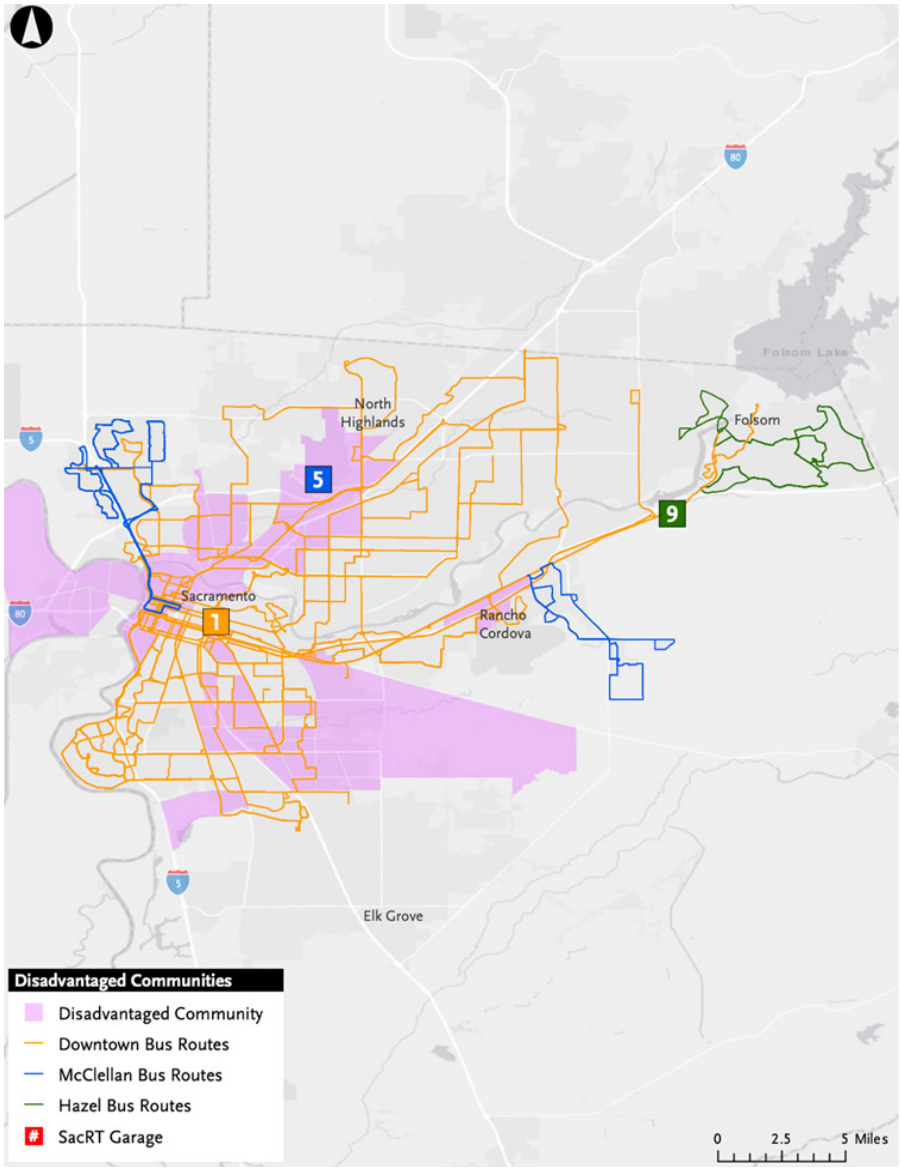
To understand ZEBs impacts on SacRT's service area, it was pertinent to establish if (1) a garage is located in a DAC, and (2) if its routes traverse DACs.

Based on analysis, McClellan is the only garage located in a DAC, meaning, it may be given priority in the transition due to the residents in that census tract potentially benefitting from the reduction of noise and emissions as a result of transitioning to ZEBs. McClellan-based blocks of service and routes also provide the largest percentage of DACs of any garage (30 percent), 22 percent of Downtown garage's communities served are DAC, and Hazel has none. Future analysis will provide more detail on route and block-specific DAC information, however, at this time, SacRT will continue to monitor these communities and consider and align them with their ZEB procurement schedule to ensure that vulnerable communities are properly served.

GARAGE	IN DAC?	NO. EXEMPT AREA?	COMMUNITIES SERVED	DACs SERVED	PCT. OF DACs SERVED
Downtown	No	No	240	44	22%
McClellan	Yes	No	26	6	30%
Hazel	No	No	17	0	0%

Table 5-1. SacRT's Disadvantaged Communities Summary | Source: CalEnviroScreen 3.0

Figure 5-1. SacRT's Disadvantaged Communities | Source: WSP; CalEnviroScreen3.0



5.2 ADDITIONAL EQUITY-FOCUSED EFFORTS

5.2.1 SACRAMENTO SUSTAINABLE COMMUNITIES RESOURCE PRIORITIES NEEDS MAP

SacRT has also recently supported and engaged in the development of Sacramento's Sustainable Communities Resource Priorities Needs Map which was spearheaded by Sacramento Municipal Utility District (SMUD), University of California, Davis, Sacramento Metro Air Quality Management District, Sacramento Area Council of Governments, and a variety of local agencies and non-profits. The Map uses data to indicate the local areas most likely to be underserved or in distress by lack of community development, income, housing, employment opportunities, and transportation. The map can then be used to develop targeted strategies to provide and promote a healthy environment, social well-being, mobility, and prosperous economy for Sacramento County most vulnerable populations. SacRT's ZEB implementation plays a key role in further pursuing a sustainable and equitable approach to transportation and development.

Additionally, the map includes a number of other GIS layers including education, tree canopy, EV charging, food deserts, and public transportation information in order to maximize and improve the equity of regional decision-making. The map is regularly monitored and interactive in a manner that allows customized searching and evaluation. The interactive storyboard format of the map allows for each section to reveal a different view of a specific map layer while explaining the nature of the vulnerability being examined.

SacRT will work with SMUD to leverage the mapping tool to improve decision-making as it relates to resource allocation, while empowering community members to take an active role in providing positive impact in their communities. The information will be used to help inform regional strategies including local, state, regional, and federal grant funding opportunities.

5.2.2 SMART RIDE ON-DEMAND MICROTRANSIT

SacRT's also serves its most disadvantaged communities by providing mobility, connectivity, health access, and overall quality of life, through cleaner forms of transportation. Since 2018, SacRT's SmaRT Ride On-Demand Microtransit service - the nation's largest mixed-ZEV on-demand fleet of its kind - provides more affordable services than traditional ride-hailing options (Lyft, Uber, etc.), which could cost riders more than five times the amount for a similar trip.

5.2.3 BUS RAPID TRANSIT

SacRT is actively progressing its planning phase of pursuing high-capacity bus services through Bus Rapid Transit, with a goal of focusing on supplementing or enhancing services in DACs. Preliminary research has concluded that multi-modal users and pedestrians are more unsafe in DACs due to the high levels of traffic and infrastructure that allows for more interactions between motorized vehicles and pedestrians. SacRT's goal is to develop BRT service that improves the safety of the community, to include exclusive rights of way and signal prioritization for buses. These BRT services will be targeted along areas that lack the infrastructure, investment, and safety, such as the Stockton Boulevard, Florin Road, Sunrise Boulevard, Arden Way and Watt Avenue corridors.

6. WORKFORCE TRAINING

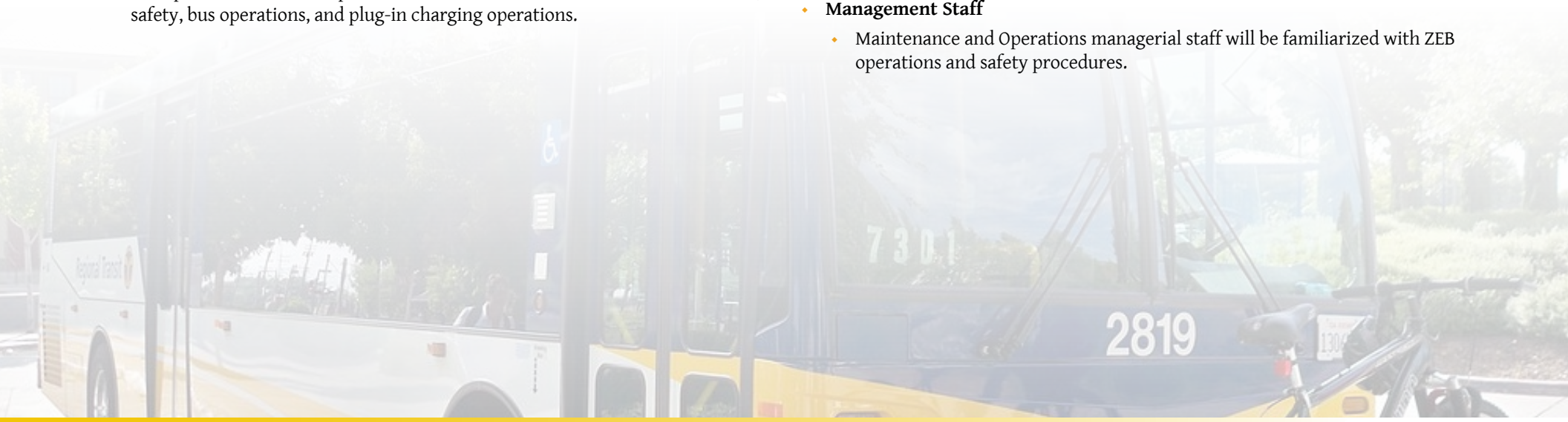
The following section provides an overview of SacRT's plan and schedule to train personnel on the impending transition.

6.1 TRAINING REQUIREMENTS

The transition to ZEBs will significantly alter SacRT's service and operations. Converting to ZEBs from CNG is an arduous endeavor and will impact all ranks of the organization. This will require extensive change management and training which will be provided by the OEMs and SacRT. Training will need to be conducted after buses are procured and in advance of the delivery of the first buses. Therefore, it is expected that all personnel will be sufficiently trained before the buses arrive. Training for the buses will be included in the purchase price and facilitated by the OEM. If other OEM-provided buses are procured in the future and/or if new components, software, or protocols are implemented, it is expected that SacRT's staff will be trained well in advance of the commissioning of these additions. Since battery technology is rapidly evolving, it is likely that buses and their supporting battery chemistries and software will change between 2020 and 2040, therefore, SacRT's future procurements/deliveries will require refresher or updated trainings for relevant staff.

The following provides a list of personnel and positions that will need to be retrained upon adoption of ZEBs (this list is not exhaustive):

- **Bus Operators and Supervisors**
  - Bus operators and field supervision will need to be familiarized with the buses, safety, bus operations, and plug-in charging operations.
- **Facilities Maintenance Staff and Maintenance**
  - Maintenance staff will need to be familiarized with scheduled and unscheduled repairs, high-voltage systems, and the specific maintenance and repair of equipment.
- **First Responders**
  - Local fire station staff will need to be familiarized with the new buses and supporting facilities.
- **Tow Truck Service Providers**
  - Tow truck providers will need to be familiarized with the new buses and proper procedures for towing ZEBs.
- **Mechanics**
  - Mechanics will need to be familiarized with the safety-related features and other components of ZEBs.
- **Instructors**
  - Maintenance and Bus Operator instructors will need to understand all aspects of the transition of ZEBs to train others.
- **Utility Service Workers**
  - Staff will become familiarized with proper charging protocol and procedures that are ZEB-specific.
- **Management Staff**
  - Maintenance and Operations managerial staff will be familiarized with ZEB operations and safety procedures.



7. COSTS AND FUNDING OPPORTUNITIES

The following section identifies preliminary capital costs and potential funding sources that SacRT may pursue in its adoption of ZEBs.

7.1 PRELIMINARY CAPITAL COSTS

While costs for a full fleet transition are still being analyzed, it is estimated that capital, alone, would be in excess of $200M. The specifics of which are dependent on what and when the technology is adopted (BEBs or FCEBs). The following provides a ROM for a full fleet conversion for both BEBs and FCEBs. A mixed fleet solution is still under consideration.

For BEBs, recent quotes from a variety of OEMs indicate that the average base purchase price is approximately $900K and $250K for a 40-foot (standard bus) and 25-foot cutaway, respectively. Chargers vary based on power output, however, a 150-kW plug-in charger with garage buildout costs amortized on a per-charger basis, are expected to cost $150K. Using these unit costs as a baseline, it would cost $201.4M for buses and chargers (alone). This does not account for the trenching, utility infrastructure, soft costs, or other costs related to the transition.

The costs of a FCEB transition are a bit more complex due to the variable unit costs of FCEB-supporting infrastructure (tanks, compressors, reformers, dispensers, etc.). However, based on ROM costs, a transition with the same number of buses is expected to start at $246.9M. This is based on the assumption of $1.2M per FCEB and two hydrogen tanks, one 15,000 gallon and one 9,000 gallon, based on the needs of SacRT's fleet size (estimated at $700K and $500K, respectively). It should be noted that this price does not include the price of the compressors, reformers, etc. that are necessary to operate hydrogen. The total estimate also includes a one-for-one replacement for cutaway/shuttle vehicles and chargers with BEBs since there are currently no FCEB cutaways on the market.

Tables 7-1 summarizes the number of buses and supporting equipment required at each division. Tables 7-2 and 7-3 present the ROM capital costs for a BEB and FCEB transition, respectively.

				BCB	FCEB
GARAGE	NO. OF 40 FT BUSES	NO. OF CUTAWAYS	TOTAL BUSES	NO. OF CHARGERS	NO. OF H2 TANKS
Downtown*	197	-	197	99	2
McClellan	-	23	23	12	-
Hazel	-	5	5	3	-
Total	197	28	225	114	2

Table 7-1. ROM Vehicle and ZEB Equipment for ZEB Conversion | Source: SacRT, August 2020

GARAGE	40-FT BUS COSTS	CUTAWAY BUS COSTS	TOTAL BUS COSTS	TOTAL CHARGER COSTS	TOTAL COSTS
Downtown*	$177.3M	-	$177.3M	$14.9M	$192.2M
McClellan	-	$5.8M	$5.8M	$1.8M	$7.6M
Hazel	-	$1.3M	$1.3M	$450K	$1.7M
Total	$177.3M	$7M	$184.3M	$17.1M	$201.4M

Table 7-2. ROM Capital Costs for BEB Conversion | Source: SacRT, August 2020

*Note: * Approximately 51 buses at Downtown would have to be relocated to another location. Assuming that SacRT maintains their existing fleet size, these 51 buses and associated chargers (26) would cost an additional $45.9M and $3.9M, respectively.*

GARAGE	40-FT BUS COSTS	CUTAWAY BUS COSTS	TOTAL BUS COSTS	TOTAL CHARGER COSTS	TOTAL TANK COSTS	TOTAL COSTS
Downtown*	$237.6M	-	$236.4M	-	$1.2M	$237.6M
McClellan	-	$5.8M	$5.8M	$1.8M	-	$7.6M
Hazel	-	$1.3M	$1.3M	$450K	-	$1.7M
Total	$237.6M	$7M	$243.4M	$2.3M	$1.2M	$246.9M

Table 7-3. ROM Capital Costs for FCEB Conversion | Source: SacRT, August 2020

*Note: * It is assumed that 15,000 and 9,000 gallon tanks would be needed to fuel 197 standard buses*

7.2 POTENTIAL FUNDING RESOURCES

There are a number of potential federal, state, local, and project-specific funding and financing sources at SacRT's disposal. To date, SacRT has applied for and been awarded for various elements of their ZE inventory, as indicated in Table 7-4.

SacRT will also continue to leverage funds from its local tax measure and pursue other strategies to meet it electrification goals, such as public-private partnerships, another grant 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
	Department of Energy (DOE)	Design Intelligence Fostering Formidable Energy Reduction and Enabling Novel Totally Impactful Advanced Technology Enhancements
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)
		Transportation Development Act
		Transit and Intercity Rail Capital Program
		Transportation Development Credits
		New Employment Credit
Local and Project-Specific		Joint Development
		Parking Fees
		Tax Rebates and Reimbursements
		Enhanced Infrastructure Financing Districts
		Opportunity Zones

Table 7-4. ZEB Funding Opportunities

8. START-UP AND SCALE-UP CHALLENGES

There are a number of challenges and opportunities that SacRT faces in converting to an all-ZEB fleet, especially in accordance with CARB ICT regulation purchasing requirements and schedule. The following briefly describes some of the challenges that SacRT faces for its transition:

Downtown Garage Space Constraints: SacRT leases its current Downtown Garage from the California Department of Transportation (Caltrans), meaning, **SacRT lacks autonomy and authority to construct or implement infrastructure without Caltrans' approval.** Of the 197 buses currently parked at the Downtown Garage, which is largely underneath a freeway, only 146 can be charged and stored given the setback and easement limitations for infrastructure.

McClellan Site Issues: The McClellan Garage can possibly accommodate the 51 buses displaced from the Downtown Garage's transition. However, it comes with many challenges. Firstly, McClellan is located far from downtown routes and would drastically increase deadhead trip distance and thus, operating costs. Additionally, McClellan is located on land formerly part of an Air Force base and is a "brownfield". Any construction onsite would require soil remediation and excessive permitting to bring buildings up to code. **These problems would incur exorbitant costs for SacRT.**

Utility Limitations: SMUD has established that a maximum of 11MW can be supplied to the Downtown Garage. This translates to a maximum of 73 150 kW charging cabinets being installed onsite, **far fewer than are required to charge the entire fleet**. This data is based on preliminary analysis and technological advancements and charge management solutions may reduce the amount of power required, however, utility enhancements would still be required.

Technological Adaptation: Currently, SacRT is modeling and planning for a transition based on existing service and ZEB technology. **Due to range limitations, current BEB technology can support roughly half of SacRT's fleet.** While future technology advancements are expected, SacRT needs to plan for what already exists. To maintain current service with today's BEB technology, SacRT would need to expand the fleet by up to 100 additional vehicles. SacRT has neither the capital budget nor the space required for these extra buses.

Costs: Adoption of ZEBs has many benefits, including potential lifecycle cost savings. However, the investment required for capital and change management will be very expensive. As previously discussed, **buses and chargers at existing fleet levels could cost $189M**. SacRT will have to be creative with funding mechanisms and sources to ensure that the transition to ZEB will not be detrimental to its operations and service. Even after capital funding is secured, the temporary relocation of buses will require deadheading that is likely not funded by grants.

Market Production Factors: The ICT regulation will put a lot of pressure on OEMs to produce ZEBs at unprecedented rates. However, it is not only California that is interested in converting to ZEBs. These monumental policy changes will have a great impact on these transitions, **making it challenging to meet ZEB goals for agencies if the supply of buses cannot meet demand**.

Phasing and Transition: Transitioning to ZEBs without any service interruptions will be very challenging due to the **limited space for temporary construction and bus relocation,** and hard deadlines.

COVID-19 Considerations: The ongoing pandemic has impacted SacRT ridership and the bus industry at large. **It is unclear of the long-term impacts to funding and public transit as a whole.** This Rollout Plan is based on pre-COVID conditions, however, due to the volatile nature of transit (even before COVID), ambitious goals will have to be flexible and adaptable based on new data and trends.

APPENDIX A

BOARD RESOLUTION