SAN BERNARDINO COUNTY TRANSPORTATION AUTHORITY

DRAFT ZERO-EMISSION BUS ROLLOUT PLAN

WSP USA Inc.

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San Bernardino, CA 92408
wsp.com

February 28, 2020

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AGENCY BACKGROUND

Transit Agency's Name	San Bernardino County Transportation Authority
Mailing Address	1170 W. 3rd Street San Bernardino, CA 92410
Transit Agency's Air District	South Coast and Mojave Desert Air Quality Management Districts
Transit Agency's Air Basin	South Coast and Mojave Desert Air Basins
Total number of buses in Annual Maximum Service[1]	City of Needles: 2 Morongo Basin Transit Authority: Mountain Area Regional Transit Authority: Omnitrans Victor Valley Transit Authority: **Total:**
Urbanized Area	Riverside – San Bernardino
Population of Urbanized Area[2]	1,932,666
Contact information of general manager, chief operating officer, or equivalent	Carrie Schindler Director of Transit and Rail 909.884.8276 cschindler@gosbcta.org
Rollout Plan Content	
Is your transit agency part of a Joint Group[3]	Yes
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?	One Rollout Plan is being submitted for all participating members of the Joint Group.
Please provide a complete list of the transit agencies that are members of the Joint Group (optional)	City of Needles, Morongo Basin Transit Authority, Mountain Area Regional Transit Authority, Omnitrans, and Victor Valley Transit Authority.

[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.

AGENCY BACKGROUND

Contact information of general manager, chief operating officer, or equivalent staff member for each participating transit agency member	**City of Needles** Cheryl Sallis Transit Services Manager 760.326.2113 csallis@cityofneedles.com **Morongo Basin Transit Authority** Mark Goodale General Manager 760.366.2395 mark@mbtabus.com **Mountain Area Regional Transit Authority** Kathy Hawksford General Manager/CEO 909.878.5200 khawksford@mountaintransit.org **Omnitrans** Erin Rogers General Manager 909.379.7100 erin.rogers@Omnitrans.org **Victor Valley Transit Authority** Kevin Kane General Manager 760.849.3262 kkane@vvta.org
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	(MM/DD/YY)
Resolution No.	XXXX
Is copy of Board-approved resolution attached to the Rollout Plan?	Yes (Appendix A)
Contact for Rollout Plan follow-up questions	Rebekah Soto Management Analyst II 909.884.8276 rsoto@gosbcta.com
Who created the Rollout Plan?	Consultant
Consultant	WSP
Cost of Rollout Plan creation	$X,XXX
Person-Hours for Rollout Plan creation	XXXX

2 EXECUTIVE SUMMARY

2.1 INTRODUCTION

In accordance with the California Air Resource Board's Innovative Clean Transportation regulation, the following report serves as the San Bernardino County Transportation Authority (SBCTA) Joint Group's Rollout Plan to transition to 100 percent zero-emission fleets by 2040. The Joint Group consists of five transit agencies within SBCTA's jurisdiction: Morongo Basin Transit Authority, Mountain Area Regional Transit Authority, City of Needles, Omnitrans, and Victor Valley Transit Authority.

2.2 BACKGROUND

2.2.1 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 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 several 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.

In accordance with the California Air Resource Board's Innovative Clean Transportation regulation (ICT regulation), the following report serves as the San Bernardino County Transportation Authority (SBCTA) Joint Group's Rollout Plan to transition to 100 percent zero-emission (ZE) fleets by 2040. The Joint Group consists of five transit agencies within SBCTA's jurisdiction: Morongo Basin Transit Authority (MBTA), Mountain Area Regional Transit Authority (MT), City of Needles Area Transit (NAT), Omnitrans, and Victor Valley Transit Authority (VVTA).

Each agencies' respective section in this report covers the following, as required per the ICT regulation:

1. **Introduction** *Details the service area, environmental factors, and schedule and operations.*
2. **Fleet and Acquisitions** *Presents the existing fleet and procurement plan for buses through 2040.*
3. **Facilities and Infrastructure Modifications** *An overview of each yard and the potential ZEB modifications.*
4. **Disadvantaged Communities** *Discusses the disadvantaged communities (DACs) that will be impacted by the ZEB transition.*
5. **Workforce Training** *Provides background on personnel training requirements for ZEB implementation.*
6. **Costs and Funding Opportunities** *Discusses rough order of magnitude costs and potential funding sources.*

7 **Start-Up and Scale-Up Challenges** *Provides an understanding of challenges and issues that the agency will have to mitigate or confront during ZEB adoption*

2.2.2 SAN BERNARDINO COUNTY TRANSPORTATION AUTHORITY'S JOINT GROUP

As mentioned, the Joint Group consists of five transit agencies: MBTA, MT, Needles, Omnitrans, and VVTA. Per the ICT regulation, each agency has different requirements based on its classification as a "Large" or "Small" Transit Agency.

Large Transit Agencies under the ICT regulation must comply with the following requirements and deadlines:

— **July 1, 2020** – Board-approved Rollout Plan must be submitted to CARB

— **January 2023** – 25 percent of all new bus purchases must be ZE

— **January 2026** – 50 percent of all new bus purchases must be ZE

— **January 2029** – 100 percent of all new bus purchases must be ZE

— **January 2040** – 100 percent of fleet must be ZE

— **March 2021 – March 2050** – Annual compliance report due to CARB

Small Transit Agencies under the ICT regulation must comply with the following requirements and deadlines:

— **July 1, 2023** – Board-approved Rollout Plan must be submitted to CARB

— **January 2026** – 25 percent of all new bus purchases must be ZE

— **January 2029** – 100 percent of all new bus purchases must be ZE

— **January 2040** – 100 percent of fleet must be ZE

— **March 2021 – March 2050** – Annual compliance report due to CARB

Within SBCTA's Joint Group, only Omnitrans is considered a Large Transit Agency, however, this document serves as the Rollout Plan for all five agencies. Meaning, Morongo Basin Transit Authority (MBTA), Mountain Area Regional Transit Authority (MT), City of Needles (Needles), and Victor Valley Transit Authority (VVTA), all classified as Small Transit Agencies, will be submitting three years earlier than required per the ICT regulation. This earlier submission not only reinforces these agencies' commitment to ZEB adoption, but it also sets the foundation for their implementation well in advance of similar-sized agencies.

2.3 BATTERY-ELECTRIC BUSES AND FUEL CELL ELECTRIC BUSES

A fuel cell electric bus (FCEB), uses hydrogen and oxygen to produce electricity through an electrochemical reaction to power the propulsion system and auxiliary equipment. This is a ZE process whose only byproduct is water vapor. FCEB can replace diesel or CNG fuel buses without significant changes to operations and service and also offers as a resilient backup alternative in case of natural disaster. The fuel cell is generally used in conjunction with a battery, which supplements the fuel cell's power during peak loads and stores electricity that is recaptured through regenerative braking, allowing for better fuel economy.

Battery electric buses (BEBs) depend on a system to store and retrieve energy much as cars and trucks need fuel. BEBs' have multiple battery packs that power an electric motor, resulting in ZE. BEBs, similar to many other battery-powered products, must be charged for a period of time to be operational. Currently, BEBs can be charged at the facility, on the route (opportunity charging) and via a number of connectors and dispensers.

2.4 ZERO-EMISSION BUS ADOPTION AND STRATEGIES

The decision on whether to adopt battery-electric buses (BEBs) and/or fuel cell electric buses (FCEBs) is largely based on availability, applicability, and costs. Due to rapidly changing technologies, it's highly likely that strategies to adopt ZEBs today may need to be adapted and revised to account for advancements and changes in ZEB technology in the future. That said, the plans presented in the Rollout Plan are subject to alterations and may not necessarily reflect the implementation strategy of each individual agency. This Rollout Plan will serve as a guiding document for ZEB implementation, or as a baseline for agencies' subsequent studies and implementation towards ZEB adoption pursuant to the ICT regulation.

The following sections summarize the existing conditions, proposed ZEB technologies, and schedule for SBCTA's five transit agencies.

2.4.1 EXISTING CONDITIONS

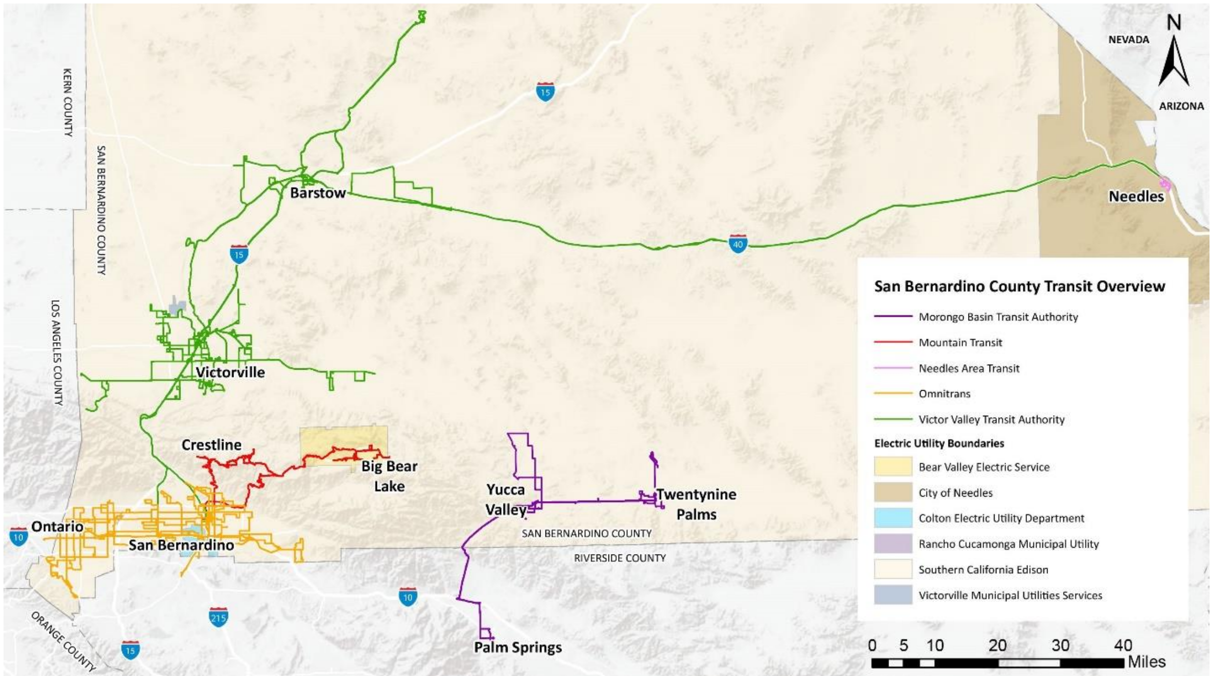
Public transit within San Bernardino County is largely provided by five local transit operators: MBTA, MT, Needles, Omnitrans, and VVTA (Joint Group). SBCTA does not currently operate transit. Together, the Joint Group accounts for approximately 12.4 million annual (unlinked) passenger trips. These agencies, however, have vastly different operations and service conditions, all of which has to be administered and coordinated by SBCTA. To determine each agency's pathway to 100 percent ZEB adoption, it is pertinent to understand their unique operating conditions and goals. By submitting as a Joint Group, commonalities such as operating conditions, vehicle types, and shared transit centers and stops can be used to ensure comprehensive planning strategies, resulting in potential cost savings, joint agreements, and a more seamless ZEB transition. Table 2-1 summarizes the existing conditions of each agency's facilities and Figure 2-1 presents the locations of each agency's facilities.

Table 2-1. Existing Conditions Summary

AGENCY	ICT CLASSIFICATION	FACILITY	# BUSES	TYPES OF BUSES	FUEL TYPE
MBTA	Small Agency	Joshua Tree	24	Cutaways	CNG
		Twentynine Palms	5	Cutaways	CNG
MT	Small Agency	Crestline	8	Cutaways	Diesel
		Big Bear Lake	12	Cutaways	Diesel
		Crestline (Future)	-	-	-
NAT	Small Agency	Needles	3	Cutaways	Diesel
Omnitrans	Large Agency	West Valley	63	Standard	CNG
		East Valley	112	Standard; Articulated	CNG
VVTA	Small Agency	Hesperia	61	Standard	CNG; BEB
		Barstow (Future)	-	-	-

Source: WSP, February 2020

Figure 2-1. SBCTA's Joint Group Facilities



Source: WSP, February 2020

2.4.2 PROPOSED ZERO-EMISSION BUS STRATEGIES

As mentioned, the decision of whether to commit to either BEBs or FCEBs is largely based on availability, applicability, and costs. Agency input, space availability, and technology applicability was assessed and considered when determining ZEB-based facility improvements. However, since ZEB technologies are constantly evolving, it is recommended that each agency approach the planning and implementation of ZEB technologies in an iterative approach. This will ensure that early adoption or committal to a specific strategy does not result in unintended consequences for an agency. Table 2-2 summarizes agencies' ZEB facility improvements.

Table 2-2. ZEB Strategies Summary

AGENCY	FACILITY	ZEB STRATEGY	BEB	# OF CHARGERS	CHARGER RATING	FCEB
MBTA	Joshua Tree	BEB	Ground-Mounted; Plug-In	13	150 kW	None at this time
	Twentynine Palms	BEB		4		
MT	Crestline	BEB	Ground-Mounted; Plug-In	4	150 kW	None at this time
	Big Bear Lake	BEB		8		
	Crestline (Future)	BEB		4		
NAT	Needles	BEB	Ground-Mounted; Plug-In	2	150 kW	None at this time

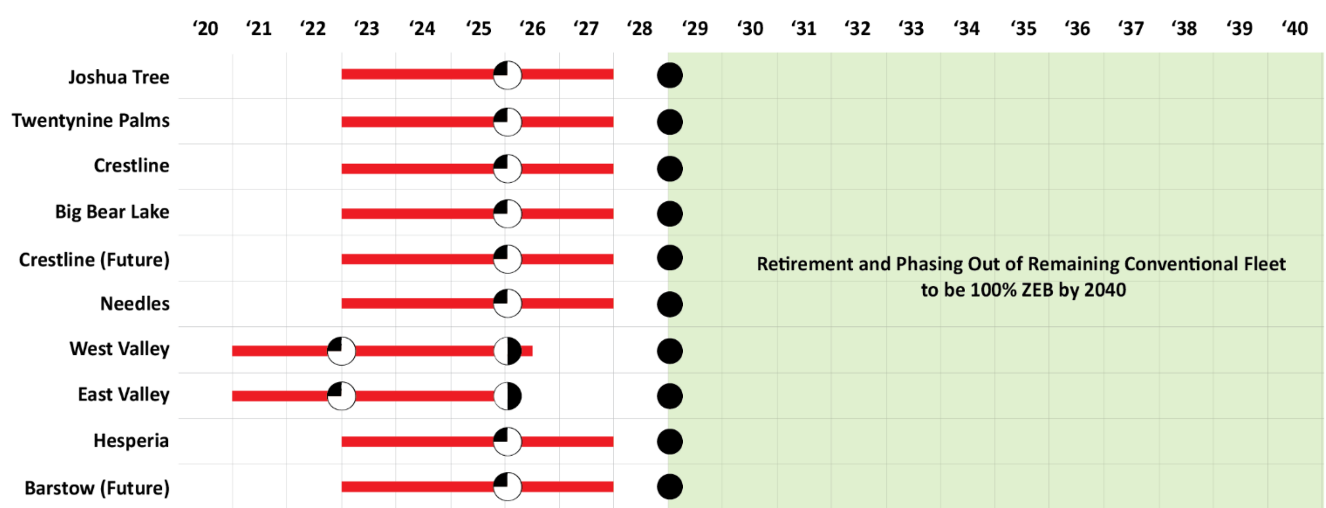
AGENCY	FACILITY	ZEB STRATEGY	BEB	# OF CHARGERS	CHARGER RATING	FCEB
Omnitrans	West Valley	BEB	Ground-Mounted; Plug-In	32	150 kW	Storage; Delivery
	East Valley	BEB	Overhead-Mounted; Plug-In	60		
VVTA	Hesperia	BEB/FCEB	Ground-Mounted; Plug-In	49	150 kW	Storage; Delivery
	Barstow (Future)	BEB/FCEB		12		

Source: WSP, February 2020
Note: Chargers are based on a 1:2 ratio (i.e., one charger for two buses).
There are no available FCEB cutaways on the market, therefore, MBTA, MT, and NAT must transition to BEB (under existing conditions)

2.4.3 PHASING AND CONSTRUCTION

The process of implementing ZEBs is 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 division. Since ZEBs are not operational unless the facilities are in place, 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. ICT regulation bus procurement requirements (percentage of new bus acquisitions) are indicated via Harvey Balls in 2023, 2026, and 2029. Figure 2-2 presents the construction schedule for each division and the various milestone purchase requirements pursuant the ICT regulation.

Figure 2-2. Summary of SBCTA's Joint Group's Construction and Purchase Schedule Per Facility



Source: WSP, February 2020

2.4.4 START-UP AND SCALE-UP ISSUES

Based on the Rollout Plan, each of SBCTA's agencies will meet the purchase and reporting requirements pursuant to the ICT regulation. However, it should be noted that the plan assumes a number of factors for this to happen. For instance, it is assumed that despite existing range issues, these will be resolved by the time an agency procures buses (i.e., each existing bus will be replaced at a 1:1 ratio). It is also assumed that funding is in place to construct and implement infrastructure in the allotted time.

After assessing each agency, a number of common themes that pose challenges to meeting the ICT regulation:

- **Uncertainty of ZEB cutaways.** There is a small market for ZEB cutaways. For the cutaways that do exist, there is uncertainty in their product range and if they're Altoona-tested. Unfortunately, the cutaway market does not currently offer FCEBs, so some agencies will be forced to adopt BEBs.
- **Operating conditions.** Some agencies fleets climb altitudes and operates in weather conditions that aren't typical of the region. These conditions have a huge impact on range, meaning, some agencies would have to invest more than other agencies to operate similar bus blocks (in terms of range).
- **Range issues.** Many agencies have many blocks that exceed current BEB *and* FCEB ranges. This means that these agencies will have to consider the following strategies to reduce or avoid service disruptions:
  - **Buy more buses.** This can assist with service requirements; however, more buses will require more chargers, more space at the division, and potentially higher utility costs.
  - **Opportunity charging.** This strategy could potentially reduce the costs (per bus) due to a smaller battery requirement, however, it would result in more capital infrastructure and utility costs.
  - **Service changes.** This would require the manipulation of block structure. While the riders may not notice the change, the agency will have to consider the potential impacts to operator and maintenance costs.
- **Technological adaptation.** With the 2040 deadline looming, it is difficult to anticipate future technological enhancements and changes, such as improved batteries and chargers. Slight changes in these technologies could improve bus ranges, in turn, reducing costs. Agencies have to be aware of these changes as it would be counterproductive to invest in technologies that will soon be outdated.
- **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. Agencies 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.
- **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, however, it will also make it challenging to meet ZEB goals for agencies if supply of buses can meet with demand.

2.4.5 NEXT STEPS

The process to transition to ZEBs should and will be iterative to minimize risk, but also to accommodate new developments in a rapidly evolving market. SBCTA will use the information outlined in both the Rollout Plan and its ZEB Transition Master Plan to identify and further refine the following:

- **BEB and/or FCEB fleet mix at each agency.** Both the Rollout Plan and the Master Plan addresses each agency's specific needs and policy choices well as making determinations about what is feasible for each. VVTA has made it clear that it is very interested in FCEBs, for example, due to concerns about range and length of its service blocks and its own experience with ZEB implementation to date. The recommendations contained herein address what this consultant team believes is the most feasible and cost-effective means of implementing the mix of ZEB types at each agency. However, all agencies will have to re-address these issues and determine whether these recommendations regarding feasibility based on costs, service requirements, and availability have changed as each agency implements its transition toward ZEBs.

- **Addressing incomplete service blocks.** The consultant team's analysis has revealed that many blocks cannot be completed when considering BEBs and FCEBs, meaning, agencies will have to determine if they're going to file exemptions, purchase additional buses, restructure service to suit technological limitations, or invest in opportunity charging. These choices are rooted in each agency's own policies and plans outside of ZEB considerations. Because the smaller agencies have the option of submitting its own rollout plan before July 1, 2023, it could elect to wait to follow the rapidly developing technology trends to determine if newly available technologies can meet longer range needs; of course, the ability file an exemption remains. It is not recommended by this team to restructure routes based on range challenges or to
- **Costs.** Construction, capital, operating, and maintenance costs vary based on a number of factors. It will be important to get an understanding of the up-front costs and lifecycle costs and savings of investing in ZEBs. The consultant team is developing such cost estimates and each agency will need to revisit these estimates to determine if pricing has changed and make implementation changes, such as changes in their purchasing schedules, accordingly.
- **Collaboration Opportunities.** Whether purchasing things via CalACT or strategizing on a joint agreement for opportunity charging, agencies can continue maximize their outcomes by engaging with other regional and local agencies. It important for all agencies to continue to participate in groups such as the ZEBRA working group, California Transit Association and the state's chapter of the Association for Commuter Transportation (ACT), the American Public Transportation Association's Bus Technology Committee and other industry working groups.

ICT regulation compliance and subsequent implementation. Only one of the five Operating Agencies with the County (OmniTrans) is required to submit a Rollout Plan by July 1, 2020. The others have the option to submit such a plan by the smaller fleet date of July 1, 2023. It is recommended that they do so, in order to monitor technology trends, market availability of new buses such as cutaways with ZE propulsion expected to come into the bus market, fuel and electricity pricing trends and the impact of contemplated service changes on these agencies' ZEB Rollout Plans. Should the County elect to file a Countywide Rollout Plan, it has the option of doing so by transmitting such an intention to CARB by no later than July 1, 2022, which satisfies the one-year notice requirement of the ICT Rule in time for submittal by the July1, 2023 date for the smaller operators. At that time, it can also notify CARB that OmniTrans' Rollout Plan will be amended such that it will join the Countywide Plan.

3 INTRODUCTION

In accordance with the California Air Resource Board's Innovative Clean Transportation regulation, the following report serves as the SBCTA Joint Group's Rollout Plan to transition to 100 percent ZE fleets by 2040. The Joint Group consists of five transit agencies within SBCTA's jurisdiction: MBTA, MT, NAT, Omnitrans, and VVTA.

3.1 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 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.

<u>Large Transit Agencies under the ICT regulation must comply with the following requirements and deadlines</u>:

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

<u>Small Transit Agencies under the ICT regulation must comply with the following requirements and deadlines:</u>

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

Within SBCTA's Joint Group, only Omnitrans is considered a Large Transit Agency, however, this document serves as the Rollout Plan for all five agencies. Thus, MBTA, MT, NAT, and VVTA - all classified as Small Transit Agencies – will be submitting three years earlier than required per the ICT regulation. This earlier submission not only reinforces these agencies' commitment to ZEB adoption, but it also sets the foundation for their implementation well in advance of similar-sized agencies.

3.2 SAN BERNARDINO COUNTY TRANSPORTATION AUTHORITY BACKGROUND

SBCTA is responsible for cooperative regional planning and furthering an efficient multi-modal transportation system for the more than 2.1 million residents of San Bernardino County. Established in 1973, SBCTA is statutorily designated to serve as San Bernardino County's transportation commission, service authority for freeway emergencies, transportation authority, and congestion management agency. SBCTA also administers Measure I, a half-cent transportation sales tax in place since 1989 (and extended through 2040 in 2004). Measure I is the largest single source of annual transportation funding available to the county, which supports freeway construction projects, regional and local road improvements, train and bus transportation, railroad crossings, call boxes, ridesharing, congestion management efforts, and long-term planning studies. To administer collected funding, the county was divided into six subareas (Figure 3-1 below) with distinct expenditure plans and policies; all money raised in a given subarea must be only used in that subarea. These subareas generally corollate to the territories of the Joint Group covered in this Rollout Plan: MBTA (Morongo Basin), MT (Mountains), NAT (Colorado River), Omnitrans (Valley), and VVTA (Victor Valley and North Desert).

Figure 3-1. San Bernardino County Subareas

Source : SBCTA, 2020

3.3 SAN BERNARDINO COUNTY TRANSPORTATION AUTHORITY'S JOINT GROUP

As previously mentioned, public transit within San Bernardino County is largely provided by five local transit operators: MBTA, MT, Needles, Omnitrans, and VVTA (Joint Group).). SBCTA does not currently operate transit. Together, the Joint Group accounts for approximately 12.4 million annual (unlinked) passenger trips. These agencies, however, have vastly different operations and service conditions, all of which has to be administered and coordinated by SBCTA. To determine each agency's pathway to 100 percent ZEB adoption, it is pertinent to understand their unique operating conditions and goals. SBCTA, as the county's regional planner, has found it to be most effective to submit a Rollout Plan on behalf of all of these agencies. By submitting as a Joint Group, commonalities such as operating conditions, vehicle types, and shared transit centers and stops can be used to ensure comprehensive planning strategies, resulting in potential cost savings, joint agreements, and a more seamless ZEB transition.

Table 3-1 shows the Joint Group agencies and their respective annual operating budgets and passenger trips.

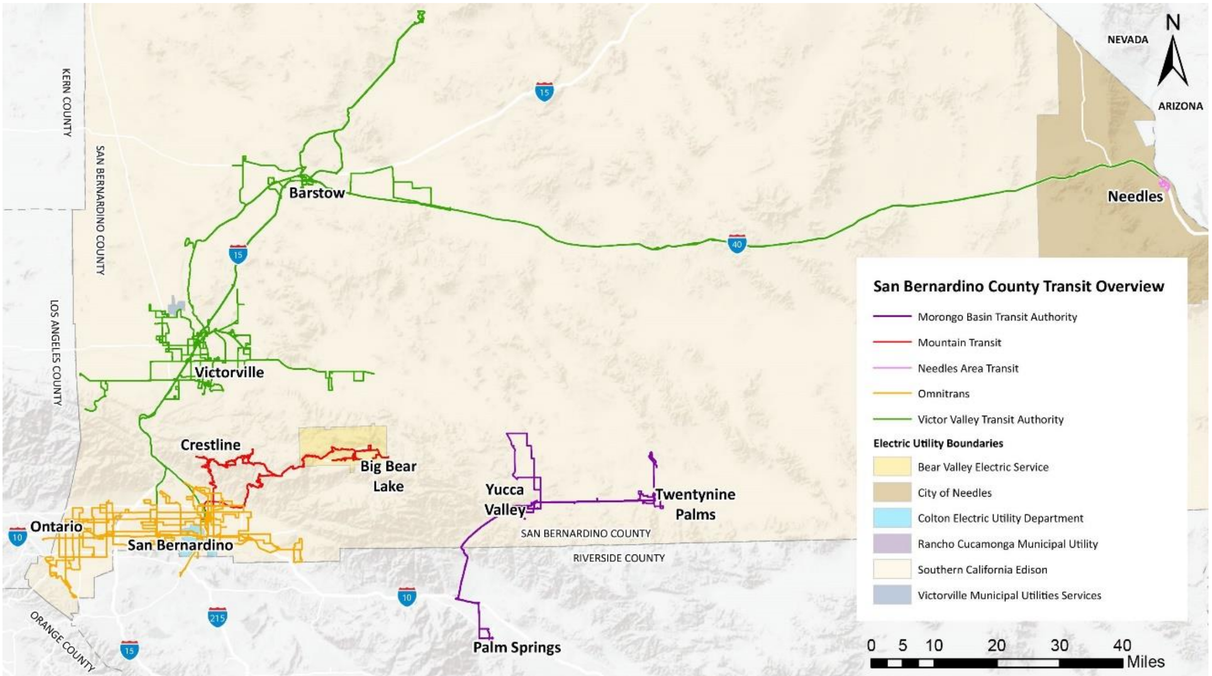
Figure 3-2 presents each agency's service area within San Bernardino County.

Table 3-1. SBCTA Joint Group's Annual Budgets and Passenger Trips

OPERATOR	ANNUAL OPERATING BUDGET (FY 2019)	ANNUAL UNLINKED PASSENGER TRIPS
MBTA	$3,463,581	258,560
MT	$3,073,781	137,930
NAT	$383,487	27,853
Omnitrans	$91,456,968	10,927,524
VVTA	$26,434,124	1,077,823

Source : WSP, February 2020

Figure 3-2. SBCTA Joint Group's Service Areas



Source : WSP, February 2020

3.4 SAN BERNARDINO COUNTY TRANSPORTATION AUTHORITY'S ZERO-EMISSION BUS EFFORTS

In April 2019, SBCTA issued a Contract Task Order to WSP USA, Inc. to conduct an analysis to determine the best path forward for the Joint Group's ZEB transition pursuant to the ICT regulation.

The goals of the analysis are three-fold for each agency within the Joint Group:

1. **Determine the most cost-effective approach to a 100 percent ZEB fleet**
2. **Determine the capital improvements required to support ZEB fleets**
3. **Provide a financing and purchasing strategy to acquire ZEBs in accordance with the ICT regulation**

The overall results of WSP's analysis will be presented in two documents, a Rollout Plan and a Master Plan. The Rollout Plan (said document) serves as the Joint Group's compliance document per CARB's ICT regulation. The Master Plan is a preliminary planning document for each agency within the Joint Group.

WSP's efforts on the Master Plan are still ongoing and many of the findings inform the Rollout Plan. The Master Plan is considered a living document, being iterative in nature due to rapid technological development and changes within the ZEB market. Therefore, some of the information outlined in this report may be superseded upon submission due to changes in technology and policy.

3.5 ROLLOUT PLAN APPROACH

Pursuant to the ICT regulation, the Rollout Plan identifies a strategy for each agency to procure and operate all ZEBs. Due to the rapidly evolving nature of ZEB technologies, it is likely 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 and planning purposes. For example, existing range constraints BEBs are assumed to be resolved by the time an agency is required to transition to ZEBs. This means that a 1:1 replacement ratio was used to match the existing service requirements. 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. That said, at the end of each agencies' respective chapter, the *Start-Up and Scale-Up Challenges* section will 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.

3.6 ROLLOUT PLAN PURPOSE AND STRUCTURE

In accordance with the Rollout Plan Guidance, this document provides an overview of several key components to SBCTA's Joint Agencies' ZEB transitions, including, but not limited to, fleet acquisitions, schedule, training, and funding considerations. Areas of ongoing study pursuant to SBCTA's ZEB Master Plan will be indicated, where applicable.

Each Joint Agency's section in this Rollout Plan is structured as follows:

1. **Introduction** *Details the service area, environmental factors, and schedule and operations.*
2. **Fleet and Acquisitions** *Presents the existing fleet and procurement plan for buses through 2040.*
3. **Facilities and Infrastructure Modifications** *An overview of each facility and the potential ZEB modifications.*
4. **Disadvantaged Communities** *Discusses the disadvantaged communities (DACs) that will be impacted by the ZEB transition.*
5. **Workforce Training** *Provides background on personnel training requirements for ZEB implementation.*
6. **Costs and Funding** *Opportunities Discusses rough order of magnitude costs and potential funding sources.*
7. **Start-Up and Scale-Up Challenges** *Provides an understanding of challenges and issues that the agency will have to mitigate or confront during ZEB adoption.*

4 MORONGO BASIN TRANSIT AUTHORITY

4.1 INTRODUCTION

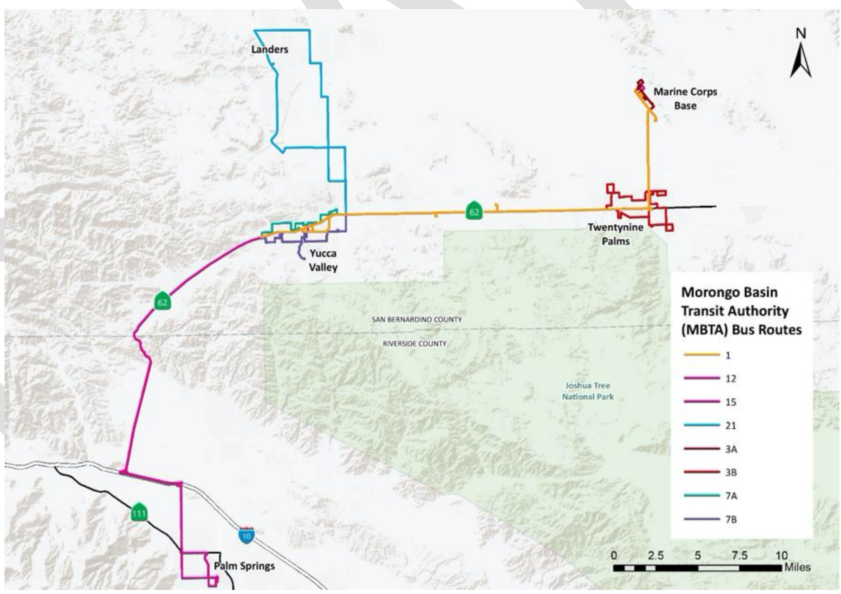
Morongo Basin Transit MBTA) operates fixed-route bus transit services with headquarters in the unincorporated community of Joshua Tree. MBTA is a joint powers authority between the Town of Yucca Valley, the City of Twentynine Palms, and San Bernardino County.

4.1.1 SERVICE AREA

MBTA operates services in Yucca Valley, Twentynine Palms, Joshua Tree, and beyond, extending south to Palm Springs in neighboring Riverside County and north to the unincorporated community of Landers. Figure 4-1 30shows MBTA's service area.

Much of the Morongo Basin's residential and commercial development is along the State Route 62 corridor between Yucca Valley in the west and Twentynine Palms in the east. This development parallels the northern border of Joshua Tree National Park and is largely the service area for MBTA shuttle routes. Two regional, long-distance routes, 12 and 15, connect the Basin to Palm Springs and Bob Hope International Airport.

Figure 4-1. MBTA Service Area



Source: WSP, February 2020

4.1.2 ENVIRONMENTAL FACTORS

MBTA's service area is predominantly in the High Desert Region, with some service extending to Palm Springs in the Low Desert area. The area's summers are hot and dry with relatively cold winters. The average high temperatures in July are over 100 degrees and average low temperatures in December through February are between 35 and 38 degrees. The region typically experiences snowfall in December (1.5-inch average) and January (.5-inch average).

Given the immense shifts in temperature due to the desert climate, power demand for HVAC systems is much more of a factor for MBTA's fleet than a typical BEB serving in a milder climate. Due to the operational range issues of ZEB vehicles, as opposed to conventional diesel or hybrid buses, these temperature variances could likely reduce vehicle range in the summer and winter months.

4.1.3 SCHEDULE AND OPERATIONS

MBTA runs three types of routes: neighborhood shuttles, intercity service, and longer-distance service to Palm Springs. MBTA's eight bus routes include:

— 1 – Intercity service between Yucca Valley and Twentynine Palms Transit Center or Twentynine Palms Marine Corps Base

— 3A – Shuttle service between Twentynine Palms Transit Center and Twentynine Palms Marine Corps Base

— 3B – Neighborhood shuttle around Twentynine Palms

— 7A – Neighborhood shuttle around North Yucca Valley, servicing the Yucca Valley Transit Center and the Walmart Center

— 7B – Neighborhood shuttle around South Yucca Valley, servicing the Yucca Valley Transit Center and Walmart Center

— 12 – Long-distance service between Yucca Valley Transit Center and Palm Springs

— 15 – Long-distance service between Twentynine Palms Marine Corps Base and Palm Springs

— 21 – Shuttle service between Landers and Yucca Valley Transit Center

The majority of MBTA's neighborhood shuttle routes run between 18 and 24 miles in length, Route 21 runs on a 48-mile loop, the intercity route runs between 27 and 43 miles, and the longer-distance routes run between 39 and 79 miles, depending on point of origin relative to Palm Springs.

While most MBTA bus routes have designated fixed stops, in some areas there are no posted bus stops, and passengers may flag the driver to board. Deviations to the fixed route are also available to passengers who are unable to get to regular fixed stops by reserving at least one hour in advance. All routes will deviate up to ¾-mile, except for Route 21, which will deviate up to 1.5 miles. These deviations add slight variability and unpredictability both to the length of runs and blocks, and to the terrain over which the buses operate.

4.2 FLEET AND ACQUISITIONS

The following section provides an overview of MBTA's existing fleet, planned purchases, and description of how MBTA will meet the requirements of the ICT regulation.

4.2.1 EXISTING BUS FLEET

As of July 2019, MBTA directly operates 24 CNG-powered cutaway buses for fixed-route service. These buses range between 25 and 36 feet in length. Table 4-1 presents a summary of MBTA's existing bus fleet.

Table 4-1. Summary of MBTA's Existing Bus Fleet

MANUFACTURER	SERIES	FUEL TYPE	LENGTH	IN SERVICE YEAR	BUS TYPE	NUMBER OF BUSES
Ford	550 Goshen	CNG	33'4"	2010	Cutaway	2
	Goshen G	CNG	33'	2011	Cutaway	1
El Dorado	XHF	CNG	33'6"	2007	Cutaway	1
	XHF Class H	CNG	36'	2012	Cutaway	3
	Class E	CNG	27'	2017	Cutaway	1
	Aero Elite Class E	CNG	32'	2017	Cutaway	2
Glaval	Class E	CNG	33'	2016	Cutaway	1
	Entourage – Class E	CNG	33'	2019	Cutaway	4
	Universal – Class E	CNG	26'6"	2011	Cutaway	1
Senator	Startrans II – Class C	CNG	25'	2018	Cutaway	6
	Startrans 550	CNG	32'	2018	Cutaway	1
Chevy	ARBOC	CNG	26'6"	2011	Cutaway	1
					Total Buses	**24**

Source: Morongo Basin Transit Authority, July 2019

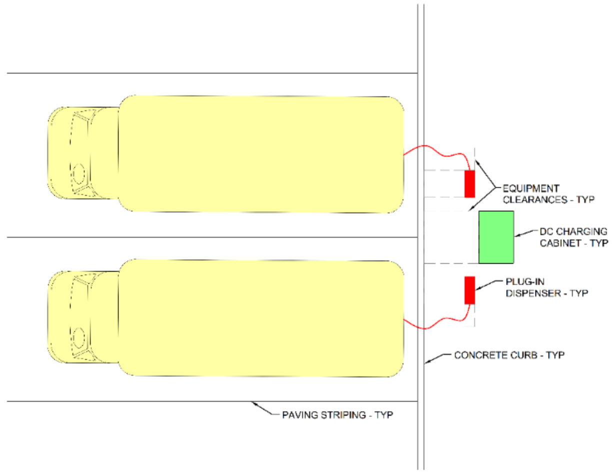
4.2.2 ZEB TECHNOLOGY APPLICATION

Past and ongoing ZEB analysis for MBTA's operations has determined that BEB adoption is the ZEB technology that best meets the needs of MBTA for their purchasing and transition requirements pursuant to the ICT regulation. FCEBs, at this time, are not feasible due to no current manufacturers offering a cutaway.

BATTERY-ELECTRIC BUS

NAT's future BEBs are expected to have specifications that are compatible with the Society of Automotive Engineers' (SAE) J1772 charging standard (e.g., "plug-in charging") (Figure 4-2). It is recommended that MBTA specify charging ports on the rear of BEBs to allow for their existing site circulation and parking patterns to continue without additional modifications. Battery sizing (kilowatts) will be determined based on service needs requirements and what is available and feasible based on costs and weight. Charger rating (kilowatt-hour) will be based on service needs, battery acceptance, and costs.

Figure 4-2. Ground-Mounted Plug-In Charger



Source: WSP, February 2020

FUEL CELL ELECTRIC BUS

Currently, there are no manufacturers in the U.S. market that offer a FCEB cutaway, deeming hydrogen power infeasible, under existing conditions. While a hydrogen-powered cutaway may be developed in the future, MBTA must plan and design for facilities and buses that are currently on the market to ensure they can comply with CARB's ICT regulation. However, as technology further develops, MBTA will remain open to technologies outside of BEB and will update plans, studies, and strategies, accordingly.

For specific blocks that are not capable of being served efficiently by existing BEB technology, FCEBs could be a viable option, if cutaways are eventually introduced to the market. In that case, it is recommended that FCEBs be fueled at future commercial/public hydrogen fueling stations located in either Twentynine Palms or Palm Springs or a purpose built MBTA containerized hydrogen storage and dispensing unit with pre-compressed hydrogen delivery on site.

4.2.3 EXISTING ZEB PROCUREMENTS AND PROJECTS

MBTA currently has no existing ZEB procurements or projects.

4.2.4 PROCUREMENT SCHEDULE

In accordance with the ICT regulation, MBTA will prioritize ZEB purchases and progressively increase the percentage of ZEB purchases over time. Based on initial analysis, the last conventional bus is expected to be purchased in 2027. All new buses purchases are anticipated to be ZEB starting in 2029.

Early retirement should not be an issue pursuant to the ICT regulation based on MBTA's assumed procurement schedule. However, if it becomes one, MBTA will deploy a number of strategies to ensure that buses fulfill their "useful life". One potential strategy is to place newly acquired buses on MBTA's longest (distance) blocks of service. This will ensure that these buses meet their distance-based useful life requirement more rapidly.

MBTA's existing fleet consists of 24 cutaway buses. Assuming a 1:1 replacement ratio, each existing bus will eventually be replaced with a BEB cutaway bus (of similar size). However, the number of ZEBs required may increase based on service requirements.

Table 4-2 presents a summary of MBTA's anticipated bus procurements through 2040. Years 2026 and 2029 are highlighted because these indicate when MBTA's new purchases should be 25 percent and 100 percent ZEBs, respectively.

Table 4-2. Summary of MBTA's Future Bus Purchases (through 2040)

		ZERO-EMISSION BUSES				CONVENTIONAL (CNG) BUSES			
YEAR	TOTAL BUSES	NUMBER	PCT.	BUS TYPE	FUEL TYPE	NUMBER	PCT.	BUS TYPE	FUEL TYPE
2020	**1**	0	0%	-	-	1	100%	Cutaway	Diesel
2021	**4**	0	0%	-	-	4	100%	Cutaway	Diesel
2022	**3**	0	0%	-	-	3	100%	Cutaway	Diesel
2023	**5**	0	0%	-	-	5	100%	Cutaway	Diesel
2024	**4**	0	0%	-	-	4	100%	Cutaway	Diesel
2025	**6**	0	0%	-	-	6	100%	Cutaway	Diesel
2026	**1**	1	100%	Cutaway	BEB	0	0%	-	-
2027	**2**	1	50%	Cutaway	BEB	1	50%	Cutaway	Diesel
2028	**0**	0	0%	-	-	0	0%	-	-
2029	**3**	3	100%	Cutaway	BEB	0	0%	-	-
2030	**11**	11	100%	Cutaway	BEB	0	0%	-	-
2031	**8**	8	100%	Cutaway	BEB	0	0%	-	-
2032	**0**	0	100%	-	-	0	0%	-	-
2033	**0**	0	100%	-	-	0	0%	-	-
2034	**1**	1	100%	Cutaway	BEB	0	0%	-	-
2035	**6**	6	100%	Cutaway	BEB	0	0%	-	-
2036	**4**	4	100%	Cutaway	BEB	0	0%	-	-
2037	**6**	6	100%	Cutaway	BEB	0	0%	-	-
2038	**4**	4	100%	Cutaway	BEB	0	0%	-	-
2039	**0**	0	100%	-	-	0	0%	-	-
2040	**6**	6	100%	Cutaway	BEB	0	0%	-	-

Note: All new purchases were assumed to have a useful life of five, seven, and 10 years per FTA Circular 9030.1D, Ch. VI, paragraph 4.a
Source: WSP, February 2020

4.2.5 ZEB RANGE REQUIREMENTS AND COSTS

MBTA operates 14 blocks during weekdays, 11 of which are longer than 100 miles. MBTA's longest blocks is approximately 230 miles. Depending on operational parameters, including operator behavior, ambient temperature, traffic, and ridership, these ranges may be unattainable or difficult to achieve on certain days. To reduce impacts to service, MBTA will consider a number of strategies to supplement onboard battery storage, including additional buses, midday charging, battery/charging management systems, and solar and battery storage. In future ZEB applications, MBTA may also consider FCEBs, especially if battery technology doesn't advance as forecasted. Table 4-3 presents the required range and estimated cost of ZEBs through 2040.

Table 4-3. Range and Estimated Costs of Future ZEB Purchases

YEAR	TOTAL ZEBS	BUS TYPES	REQUIRED RANGE (MI.)	ESTIMATED COST/BUS
2026	1	BEB	160	$1,000,000
2027	1	BEB	170	$1,000,000

2029	3	BEB	190	$1,000,000
2030	11	BEB	200	$1,000,000
2031	8	BEB	210	$1,000,000
2034	1	BEB	240	$1,000,000
2036	4	BEB	260	$1,000,000
2037	6	BEB	270	$1,000,000
2038	4	BEB	280	$1,000,000
2040	6	BEB	300	$1,000,000

Source: WSP, February 2020

4.2.6 ZEB CONVERSIONS

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

4.3 FACILITIES AND INFRASTRUCTURE MODIFICATIONS

The following sections detail the planned charging strategies, infrastructure, detailed yard improvements, and program schedule.

4.3.1 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. For that reason, the recommended facility and infrastructure modifications are based on what can physically be accommodated at each facility. This is based on the number of existing vehicles plus a predetermined growth factor (or space at the division). This provides the agency with a ceiling for what can physically be constructed and at what cost. Service changes and bus movements may happen multiple times a year, for some agencies. By establishing a full build scenario, agencies can optimize, and tailor strategies based on existing (or anticipated) service for implementation.

The analysis of FCEBs at each agency is ongoing, however, a hydrogen storage footprint was established at each division where vehicles and space can support it. Further analysis (Master Plan and subsequent studies) will analyze alternatives of hydrogen delivery.

In the case of MBTA, the full build scenario is presented for context. However, refinements and tailored strategies will be developed in the Master Plan and future implementation studies.

4.3.2 FACILITY MODIFICATIONS

MBTA's transition to ZE technologies, namely, BEB, will require a number of modifications and changes to existing infrastructure and operations. This would include the decommissioning of CNG equipment, enhancements and expansions of electrical equipment, additional electrical capacity, and the installation of BEB chargers, dispensers, and other components. These modifications will occur at MBTA's two yards in Joshua Tree and Twentynine Palms.

Based on MBTA's existing service needs and site configurations, MBTA plans on installing ground-mounted plug-in chargers to support BEBs at both Joshua Tree and Twentynine Palms yards. The proposed full facility layout is based on utilizing a 150-kW DC charging cabinet used in a 1:2 charging ratio (one DC charging cabinet energizes two separate plug-in cord dispensers). This charger to dispenser ratio would meet the requirements to charge MBTA's fleet during the vehicles' servicing and dwell time on the site while minimizing the peak electrical demand. Figure 4-3 illustrates the location of the MBTA's yards.

Table 4-4 summarizes the modifications and schedule of each yard and the following sections detail the process of each yard's transition from existing conditions to BEB-readiness.

Figure 4-3. MBTA's Yard Locations

Source: WSP, February 2020

Table 4-4. MBTA Yard Summary

GARAGE	ADDRESS	MAIN FUNCTIONS	PLANNED INFRASTRUCTURE	EXISTING/REQ'D CAPACITY (MW)	UPGRADES REQ'D?	TIMELINE
Joshua Tree	62405 Verbena Rd. Joshua Tree, CA	Fueling, Storage, and Maintenance	Plug-In Charging to support 26 buses by 2025	5 MW	Yes	2023-2028
Twentynine Palms	6994 Bullion Ave. Twentynine Palms, CA	Fueling and Storage	Plug-In Charging to support 10 buses by 2025	5 MW	Yes	2023-2028

Source: WSP, February 2020

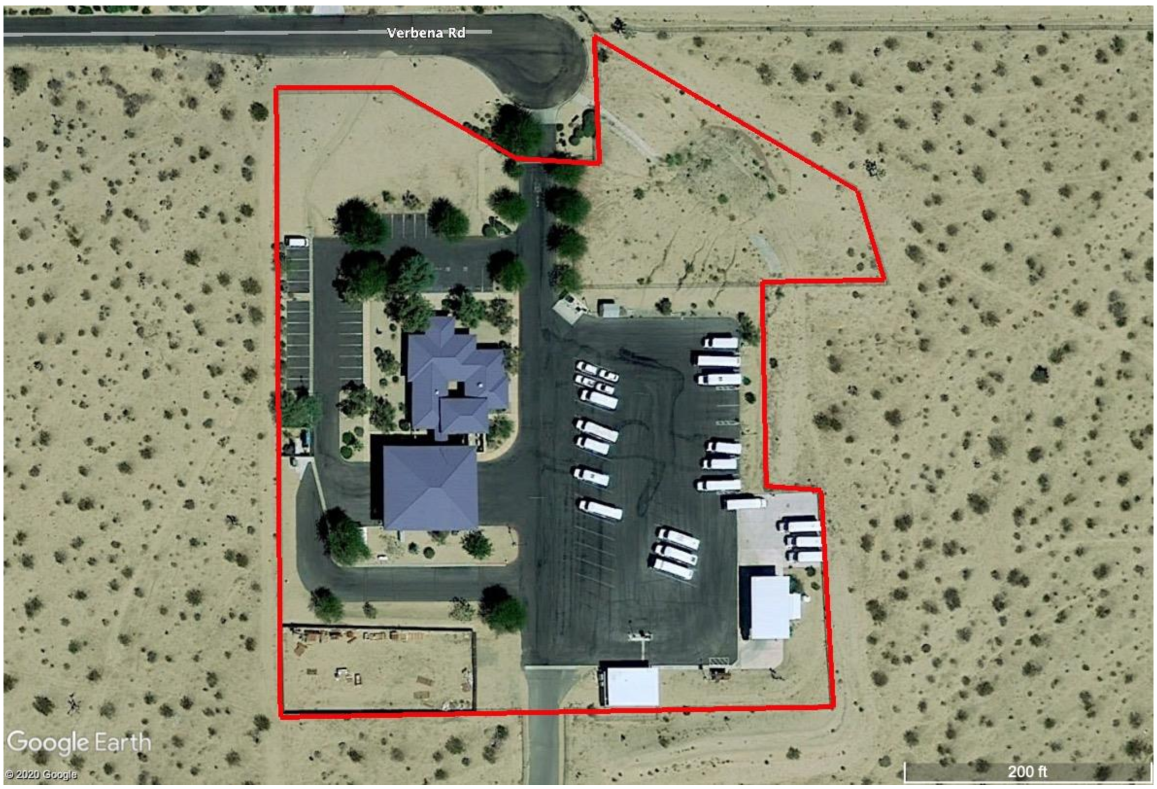
JOSHUA TREE YARD

EXISTING CONDITIONS

Joshua Tree Yard is located at 62405 Verbena Road in the City of Joshua Tree. The yard has an existing electrical capacity of XX MW with electrical service provided by Southern California Edison (SCE).

Currently, 26 CNG-powered buses are stored, maintained, fueled, and serviced at the yard. Buses are parked one-deep in angled tracks in the yard or backed in along the eastern fence line. Buses fuel with CNG when they return to the site at the end of daily service via one of two fast-fill CNG positions at the fuel canopy on the southeast corner of the site, or in one of the ten time-fill positions located along the northeastern edge of the parking lot. Washing is handled by service staff in mornings via a pressure wash unit located under a canopy on the southeast boundary of the site.

Figure 4-4. Joshua Tree Yard - Existing Conditions



Source: Google Earth, February 2020

Figure 4-5. Joshua Tree Yard's Maintenance Facility

Source: WSP, February 2020

PLANNED ZEB MODIFICATIONS

Based on the recommended ground-mounted DC plug-in charging solution, the Joshua Tree Yard is capable of parking 29 buses with 26 plug-in charging positions in a 1:2 charger to bus dispenser ratio.

Table 4-5 summarizes the ZEB infrastructure planned at the Joshua Tree Yard.

Table 4-5. Joshua Tree Yard Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY*
MBTA	Joshua Tree	Ground-Mounted; Plug-In	13	26	150 kW	Storage/ Delivery

Source: WSP, February 2020
Note: At this time, there are no current cutaway FCEBs on the market, however, if one is developed and MBTA determines adoption is feasible, on-site fueling/storage is recommended.

The following BEB equipment and locations are proposed:

— Five charging cabinets with 10 plug-in dispenser charging positions along the northeastern yard pavement edge in the existing CNG slow-fill area.

— Two charging cabinets with four plug-in dispenser charging positions along the eastern site pavement edge in the parking space north of the wash canopy.

— Six island-mounted charging cabinets with 12 plug-in dispenser charging positions in the existing angled yard parking in the center of the yard.

The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

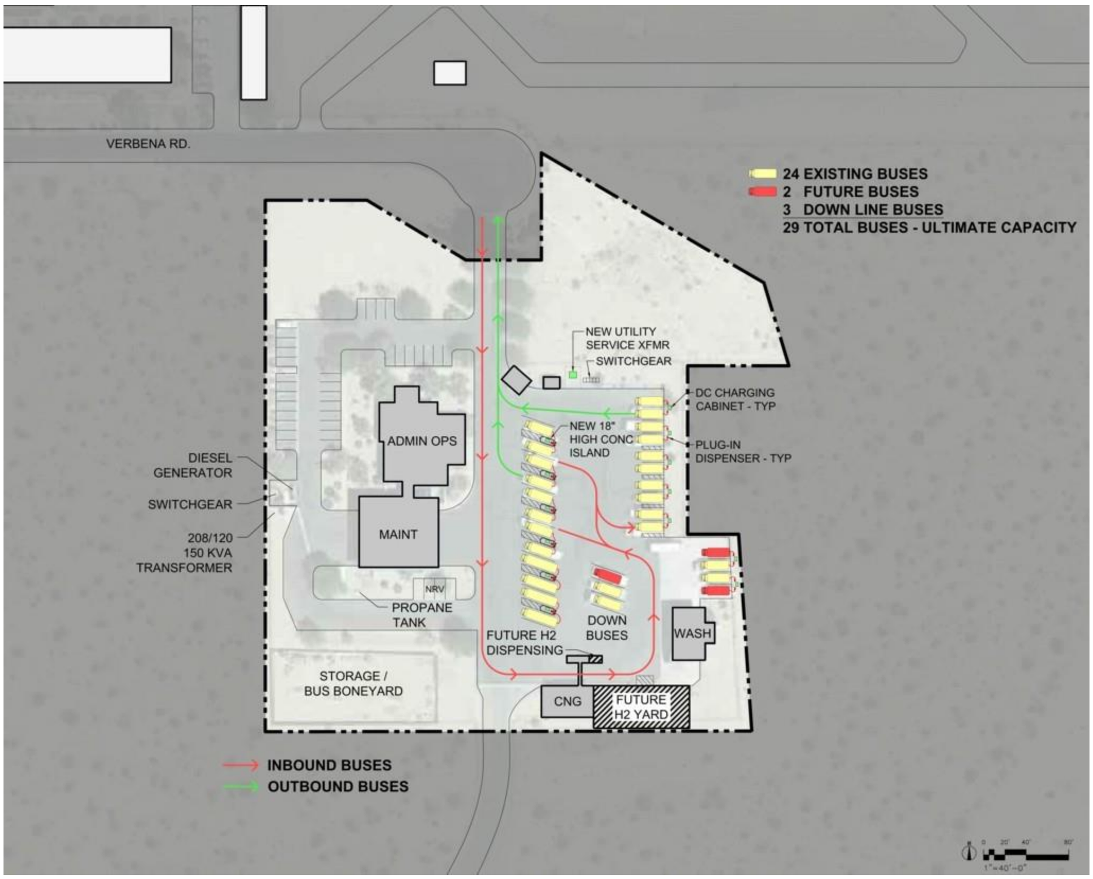
— One medium voltage utility service transformer in a new utility yard in the open space north of the existing parking yard and east of the site entrance.

— One switchgear in a new utility yard in the open space north of the existing parking yard and east of the site entrance.

The primary vehicles used for service out of Joshua Tree are cutaway buses, which are currently not available as FCEBs. For this reason, hydrogen power at Joshua Tree is not recommended. As these technologies become available in the future, Morongo Basin may consider hosting a hydrogen fueling yard located on the southern portion of the site adjacent to the existing CNG yard if commercially available hydrogen fueling stations are not utilized. WSP recommends utilizing a containerized hydrogen solution with hydrogen delivered pre-compressed to meet hydrogen fueling needs as the volume of hydrogen required does not justify the high infrastructure costs associated with on-site generation and/or compression.

Figure 4-6 illustrates the Joshua Tree Yard at full build-out.

Figure 4-6. Joshua Tree Yard – Full ZEB Build-Out



Source: WSP, February 2020

TWENTYNINE PALMS YARD

EXISTING CONDITIONS

Twentynine Palms Yard is located at 6994 Bullion Avenue in the City of Twentynine Palms. The yard has an existing electrical capacity of XX MW with electrical service provided by SCE.

Currently, eight CNG-powered buses are stored and fueled at the division. The Twentynine Palms Yard site consists of the following separate structures and major site areas: bus parking, a portable restroom for operators, stand-alone fuel island, and an adjacent CNG compressor yard with support equipment. To the north, the rest of the site is used for storage, maintenance, and operations by the public works department.

Buses enter from Bullion Avenue and are backed in along the eastern and southern fence line for nightly parking. Buses fuel with CNG when they return to the site at the end of daily service via either single fast-fill

CNG position on the fuel island on the southeast corner of the site or in one of the six time-fill positions located along the southern edge of the parking lot

No maintenance, dispatch, or wash facilities are located on the Twentynine Palms Yard site for MBTA.

Figure 4-7. Twentynine Palms Yard - Existing Conditions

Source: Google Earth, February 2020

Figure 4-8. Twentynine Palms Yard Bus Parking and CNG Fueling

Source: WSP, February 2020

PLANNED ZEB MODIFICATIONS

Based on the recommended ground-mounted DC plug-in charging solution, the Twentynine Palms Yard is capable of parking eight buses with eight plug-in charging positions in a 1:2 charger to bus dispenser ratio.

Table 4-6 summarizes the ZEB infrastructure planned at the Twentynine Palms Yard.

Table 4-6. Twentynine Palms Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY*
MBTA	Twentynine Palms	Ground-Mounted; Plug-In	4	8	150 kW	N/A

Source : WSP, February 2020

The following BEB equipment and locations are proposed:

— Four charging cabinets with 10 plug-in dispenser charging positions along the southern yard pavement edge in the existing CNG slow-fill area.

The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

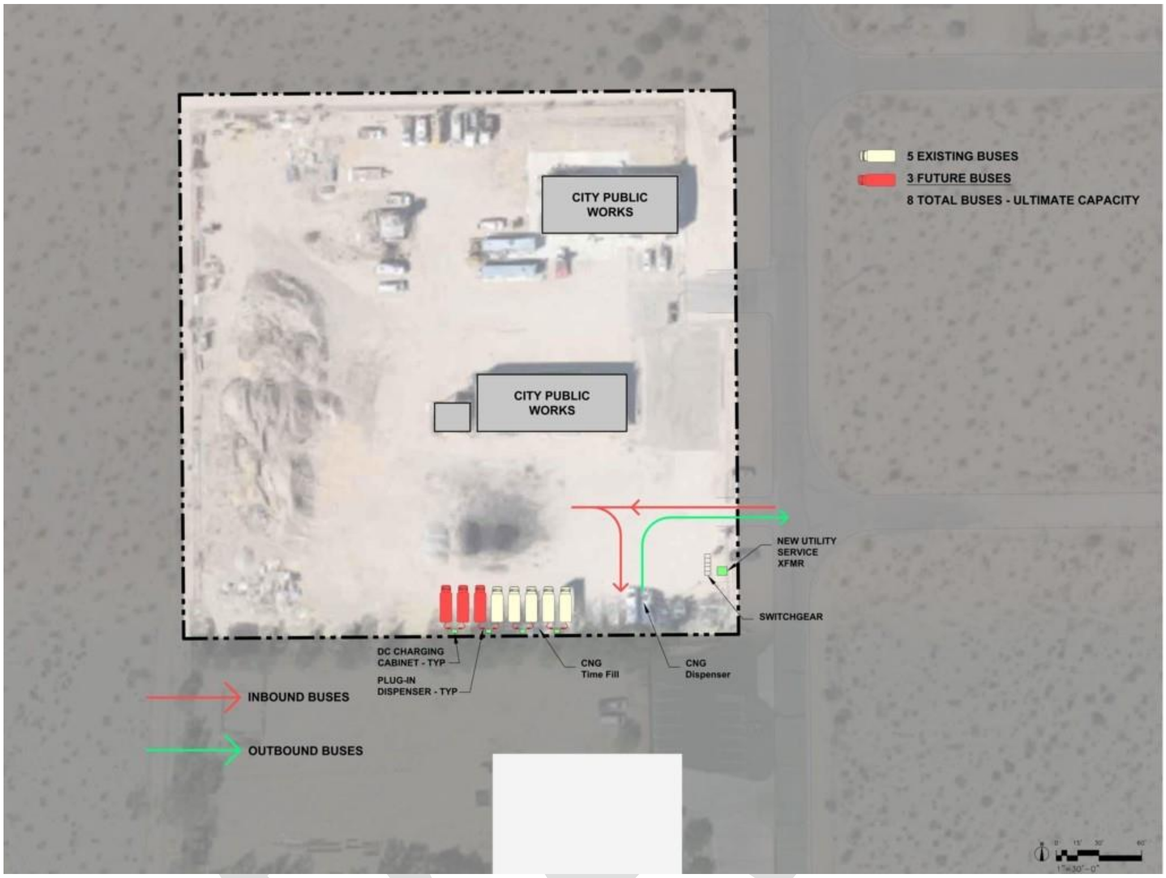
— One medium voltage utility service transformer in the open space north of the existing CNG yard and south of the eastern site entrance.

— One switchgear utility service transformer in a new utility yard in the open space north of the existing CNG yard and south of the eastern site entrance.

Hydrogen fueling is not recommended for this site due to the limited number of vehicles operating from the Twentynine Palms Yard.

Figure 4-9 illustrates the Twentynine Palms Yard at full build-out.

Figure 4-9. Twentynine Palms Yard – Full ZEB Build-Out



Source: WSP, February 2020

4.3.3 PHASING AND CONSTRUCTION SCHEDULE

Adhering to the construction schedule and milestones will be critical because the facilities' construction must be completed before buses are delivered, otherwise, the buses will not be able to operate. To accomplish this, construction for BEB-supporting infrastructure is expected to be done in phases to minimize disruption of operations. Joshua Tree Yard is expected to be completed in two phases, and Twentynine Palms Yard is expected to be completed in one.

Additional electrical capacity will be required to meet the service needs of buses at both yards. Construction and enhancements to bring this additional electrical capacity is anticipated to take three to five years based on SCE's protocol. This timeframe would include method of service studies, design, and construction. It is recommended that electrical infrastructure such as transformers and switchgears be installed with the initial phase at both Joshua Tree and Twentynine Palms yards to avoid the disruption of ongoing charging operations.

The following provides details on recommended phasing for each yard.

JOSHUA TREE YARD

PHASE 1

The first phase of charger installation the for the Joshua Tree Yard is to install all of the in-ground conduit to route electrical service to seven charging cabinets with 14 plug-in dispensers mounted at the edge of the parking spaces on the eastern boundary of the yard. These chargers and dispensers can be installed without any trenching modification to the existing paved parking areas.

PHASE 2

Phase 2 at Joshua Tree should complete all yard trenching to distribute electrical service to the central yard parking and construct all of the islands to house the charging cabinets and dispensers. Charging cabinets and dispensers can then be added to the islands as needed with the phase-in of BEBs.

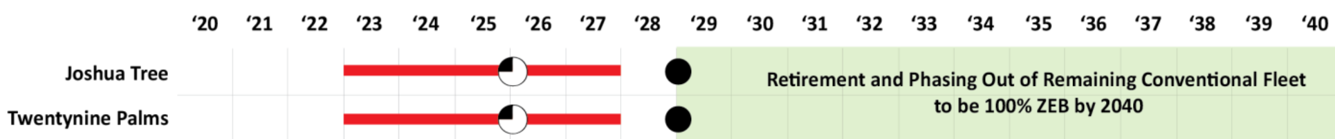
TWENTYNINE PALMS YARD

PHASE 1

Based on the size of the Twentynine Palms site and the lower number of vehicles to be charged, WSP recommends completing the entire BEB charging installation in a single phase at the Twentynine Palms site.

Figure 4-10 presents the proposed construction schedule for MBTA's transition to ZEBs. This schedule incorporates RFP development/award, design, utility construction, and ZEB infrastructure construction. The Harvey Balls indicate the percentage of new buses that need to be ZEB pursuant to the ICT regulation.

Figure 4-10. MBTA Construction Schedule



Source: WSP, February 2020

4.4 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, as 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.

4.4.1 MBTA'S DISADVANTAGED COMMUNITY ANALYSIS

To understand ZEBs impacts on MBTA's service area, it was pertinent to establish if: 1) its garages are in a DAC; and 2) if its routes traverse DACs.

At this time, neither the Joshua Tree Yard nor Twentynine Palms Yard is in an area considered "disadvantaged". Its routes currently traverse 19 and 25 census tracts, respectively, all of which are not considered disadvantaged by the CalEnviroScreen tool.

Table 4-7 summarizes MBTA's yards and census tracts served in terms of DACs.

Table 4-7. MBTA's Disadvantaged Communities

YARD	IN DAC?	NOX EXEMPT AREA?	COMMUNITIES SERVED	DAC'S SERVED	PCT. OF DACS SERVED
Joshua Tree	No	Yes	19	0	0%
Twentynine Palms	No	Yes	25	0	0%

Source : WSP, February 2020

4.5 WORKFORCE TRAINING

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

4.5.1 TRAINING REQUIREMENTS

The transition to ZEBs will significantly alter MBTA's service and operations. Converting to ZEBs from diesel is an arduous endeavor and will impact all ranks of the organization. This will require extensive change management and training, some of which will be provided by the original equipment manufacturers (OEMs), others by MBTA and outside organizations. Training will need to be conducted well in advance of the delivery of the first buses and will be ongoing throughout the lifecycle of the technology.

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
  Bus operators will need to be familiarized with the buses, safety, bus operations, and pantograph operations.

— Facilities Maintenance Staff and Maintenance
  Facilities 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.

— Body Repairers
  Body repairers will need to be familiarized with the safety-related features and other components of ZEBs.

— Instructors
  Instructors will need to understand all aspects of the transition of ZEBs to train others.

— Service Attendants
  Service attendants will become familiarized with proper charging protocol and procedures that are ZEB-specific.

— Management Staff
  All Management (supervisors, directors, etc.) will be familiarized with ZEB operations and safety procedures.

Table 4-8: MBTA's ZEB Training Summary

TRAINING PROGRAM/CLASS	PURPOSE OF TRAINING	NAME OF PROVIDER	NUMBER OF TRAINEES	TRAINEES' POSITIONS	TRAINING HOURS	TRAINING FREQUENCY	ESTIMATED COSTS PER CLASS

Source : WSP, February 2020

4.6 COSTS AND FUNDING

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

4.6.1 PRELIMINARY COSTS

As expected, the cost of ZEB adoption is going to be very expensive. While actual costs (capital and operations & maintenance) of the transition are still being determined and evaluated, it is assumed that a full transition for just the buses and chargers (based on existing conditions) will cost approximately $15.6 million (in 2020 dollars). This assumes of approximately $100K and $50k for charging equipment (DC cabinets and dispensers) and support equipment (conduit, trenching, cabling, etc.), respectively, per bus. This also includes an assumed cost of $500K per bus, however, this will vary depending on length, customizations, etc.

4.6.2 POTENTIAL FUNDING SOURCES

There are a number of potential federal, state, local, and project-specific funding and financing sources at MBTA's disposal. MBTA will monitor funding cycles and pursue opportunities that yield the most benefits for the agency pursuant to the ICT regulation. The following table identifies the many funding opportunities that MBTA may take advantage of in the next 20 years.

Table 4-9. MBTA's ZEB 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
	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

Source : WSP, February 2020

4.7 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 MBTA has identified. The following sections briefly describe some of the challenges that MBTA faces for its transition.

— **Uncertainty of ZEB cutaways.** As discussed, there is a small market for ZEB cutaways. For the cutaways that do exist, there is uncertainty in their product range and if they're Altoona-tested. Unfortunately, the cutaway market does not currently offer FCEBs, so MBTA has no other alternative and will have to plan on BEB adoption.

— **Range issues.** MBTA has some blocks that exceed current BEB range. This means that MBTA will have to consider the following strategies to reduce or avoid service disruptions:

  — **Buy more buses.** This can assist with service requirements; however, more buses will require more chargers, more space at the division, and potentially higher utility costs.

  — **Opportunity charging.** This strategy could potentially reduce the costs (per bus) due to a smaller battery requirement, however, it would result in more capital infrastructure and utility costs.

  — **Service changes.** This would require the manipulation of block structure. While the riders may not notice the change, the agency will have to consider the potential impacts to operator and maintenance costs.

- **Technological adaptation.** Currently, MBTA is modeling and planning for a transition based on existing service and ZEB technology. With the 2040 deadline looming, it is difficult to anticipate future technological enhancements and changes, such as improved batteries and chargers. Slight changes in these technologies could improve bus ranges, in turn, reducing costs. MBTA (and the market) needs to be aware of these changes as it would be counterproductive to invest in technologies that will soon be outdated.
- **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. MBTA 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.
- **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, however, it will also make it challenging to meet ZEB goals for agencies if supply of buses can meet with demand.

5 MOUNTAIN AREA REGIONAL TRANSIT AUTHORITY

5.1 INTRODUCTION

MT was formed as a joint powers authority between the City of Big Bear Lake and the County of San Bernardino, providing service between the City of San Bernardino and the San Bernardino mountain communities. MT's ridership peaks between December and March, when tourists are drawn to the robust ski industry in the San Bernardino Mountains during snowy winter months.

5.1.1 SERVICE AREA

MT provides two primary transit services - fixed-route bus service and dial-a-ride. It operates local shuttle services in and between Big Bear Lake, Lake Arrowhead, the surrounding mountain communities, and intercity connection services between these communities and the City of San Bernardino. Through the latter service, MT provides connections to Omnitrans, Metrolink, and private commercial bus service. In addition to its primary destination cities - Big Bear Lake, Crestline, and San Bernardino - MT provides service in the following mountain communities: Crestline, Erwin Lake, Highland, Moonridge, and Running Springs. Figure 5-1 shows MT's service area.

Figure 5-1. MT Service Area

Source: WSP

5.1.2 ENVIRONMENTAL FACTORS

MT faces two considerable obstacles in providing its service - weather and terrain. These will undoubtedly also influence MT's electrification process. Because MT operates in both the mountain communities and the City of San Bernardino, its fleet must be able to handle a wide variety of weather conditions. While much of San Bernardino County experiences a hot, arid desert climate, the area around Big Bear Lake experiences significant snowfall during the winter months. Winter average low temperatures in Big Bear Lake are between

21 and 22 degrees, while in the City of San Bernardino average lows in those same months are between 41 and 43. On a given winter day, a bus could begin its service day in the City of San Bernardino with a mid-day high temperature of 68 degrees (average high for January) and conclude its day in Big Bear Lake with a low temperature of 21 degrees (average low for January). The summer months offer a similar juxtaposition, high temperatures in the City of Big Bear Lake average 81 degrees in July, compared with 96 degrees in the City of San Bernardino.

There is also a stark contrast in terrain and elevation between the mountain communities and the City of San Bernardino. Big Bear Lake's elevation is 6,750 while the City of San Bernardino is approximately 1,000 feet, meaning MT must both operate at high altitude *and* climb to that high altitude from the valley floor. Snow typically begins at 5,000 feet but can reach as low as 3,000 feet during storms. To combat these environmental challenges, all MT buses are equipped with auto-chains for their tires. If chains were to be used for ZEBs, these chains would need to be a consideration when modeling battery consumption.

Additionally, many of the roads between the mountain villages - especially in the Rim of the World (RIM is a common term for the Lake Arrowhead and Crestline areas) and even some portions of the roads traveling up the mountain - are very narrow and have many curves. These roads present difficulty for buses in all seasons, but especially during the winter months, when snow can lead to slipping and traffic delays. State Routes 18 and 330 provide over-the-mountain (OTM) access to Lake Arrowhead and Big Bear Lake, respectively. Both roads feature grades of up to seven percent, which presents a challenge, snow notwithstanding. The steep grades of the roads that climb the mountain also present an unusual challenge for a transit system. Electric motors, which have higher torque and better acceleration from low speeds and on hills, should provide benefits to MT in meeting these challenges; however, the terrain, coupled with the low temperatures, will reduce the range of BEBs, reducing the length of blocks that can be completed. In addition, the narrow and mountainous roadways demand service reliability, meaning that greater scrutiny should be observed in calculating the range of vehicles operating on these challenging bus routes. FCEBs can largely meet range concerns, yet the concern lies in the fact that there is no close proximity to hydrogen infrastructure and delivery on the mountain during severe weather.

5.1.3 SCHEDULE AND OPERATIONS

MT operates service on seven fixed routes. Three routes are local shuttles in the City of Big Bear Lake, two are local shuttles in the RIM area, and the final two provide intercity OTM service between the two service areas and the City of San Bernardino. Odd-numbered routes correspond to Big Bear Valley service, and even-numbered routes correspond to the RIM/Lake Arrowhead area.

The three local shuttles in Big Bear Lake are:

— 1 – Boulder Bay to Interlaken Center, serving The Village and Bear Mountain

— 3 – Mountain Meadows to Bear Mountain and Interlaken Center

— 11 – Erwin Lake to Interlaken Center, serving Big Bear Lake, Big Bear City, and Sugarloaf

The two local shuttles in the RIM area are:

— 2 – Valley of Enchantment to Lake Arrowhead, serving Crestline

— 4 – Lake Arrowhead to Running Springs

The two OTM routes are:

— 5 – Big Bear Valley San Bernardino, servicing Running Springs

— 6 – Lake Arrowhead to San Bernardino, servicing Crestline

All routes that service Big Bear Lake run daily; OTM service runs one fewer trip on the weekends. For routes that service Lake Arrowhead, all routes operate on full schedule Monday to Friday. On Saturdays, Routes 2 and 4 operate a full schedule, while Route 6 operates a limited schedule. Only Route 2 operates on Sunday and does so on a limited schedule.

Additionally, MT operates a weekend trolley service in Big Bear Lake and a summer seasonal weekend trolley service (mid-May to mid-October) from Lake Arrowhead to Lake Gregory. The Big Bear Trolley runs hourly on Saturdays from 9:30 AM to 9:30 PM and on Sundays from 11:30 AM to 2:30 PM. On holiday weekends MT uses a Saturday schedule on Sunday and a Sunday schedule on Monday. The RIM area trolley runs roughly every hour and 40 minutes from 1:40 PM to 8:40 PM.

5.2 FLEET AND ACQUISITIONS

The following section provides an overview of MT's existing fleet, planned purchases, and description of how MT will meet the requirements of the ICT regulation.

5.2.1 EXISTING BUS FLEET

As of July 2019, MT directly operates 19 diesel-powered cutaway buses for fixed-route service. These buses range between 25 and 37 feet in length. Table 5-1 presents a summary of MT's existing bus fleet.

Table 5-1. Summary of MT's Existing Bus Fleet

MANUFACTURER	SERIES	FUEL TYPE	LENGTH	IN SERVICE YEAR	BUS TYPE	NUMBER OF BUSES
Freightliner	Glaval Legacy	Diesel	37'	2016	Cutaway	2
	El Dorado Aeroelite 270-C	Diesel	27.5'	2015	Cutaway	2
	Glaval F550-AZ	Diesel	32.5'	2015	Cutaway	1
				2016	Cutaway	2
	Glaval Entourage AZ	Diesel	32.5'	2016	Cutaway	2
	Trolley F53 w/V10 Trinitron - AZ	Diesel	30'	2016	Trolley	1
	F550 Class E - Creative	Diesel	27.5'	2016	Cutaway	2
	Trolley F550 Creative	Diesel	25'	2018	Trolley	1
	E450 Glaval AZ	Diesel	27.5'	2018	Cutaway	4
Bluebird	Microbird E450	Diesel	27.5'	2018	Cutaway	1
			25'	2018	Cutaway	1
					Total Buses	**19**

Source: Mountain Area Regional Transit Authority, July 2019

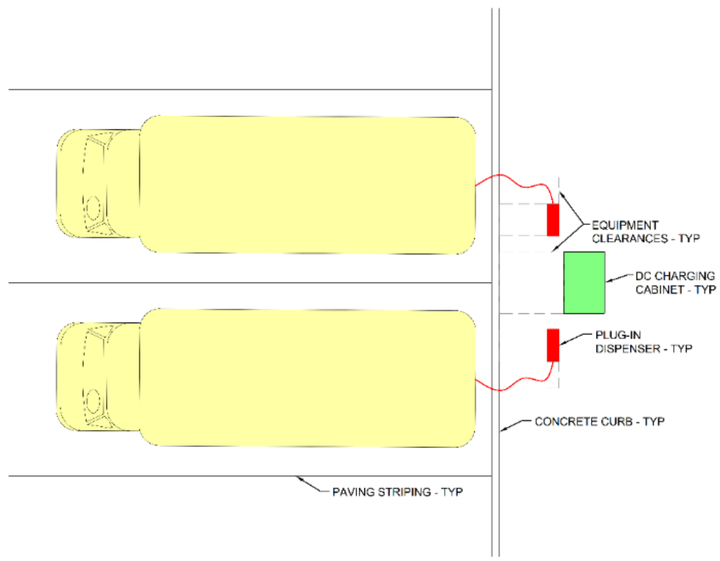
5.2.2 ZEB TECHNOLOGY APPLICATION

Past and ongoing ZEB analysis for MT's operations has determined that BEB adoption is the ZEB technology that best meets the needs of MT for their purchasing and transition requirements pursuant to the ICT regulation. FCEBs, at this time, are not feasible due to no current manufacturers offering a cutaway.

BATTERY-ELECTRIC BUS

MT's future BEBs are expected to have specifications that are compatible with the SAE J1772 charging standard (e.g., "plug-in charging") (Figure 5-2). It is recommended that MT specify charging ports on the front and rear of BEBs to allow for their existing site circulation and parking patterns to continue without modifications as both head-in and back-in parking are used in existing MT parking operations. Acquiring buses with the dual port locations will allow for vehicles to operate from all of the sites with no restrictions based on charger layout.

Figure 5-2. Ground-Mounted Plug-In Charger



Source: WSP, February 2020

Any buses which will perform OTM service are recommended to be procured with overhead charging rails (Figure 5-3) to utilize potential opportunity charging that is being considered at the San Bernardino Transit Center (SBTC) for range extending. An alternative "no charging rails" solution would need to identify a non-publicly accessible/isolated layover space for 30+ minute layover space where a BEB could be connected to a plug-in charger. Note that current plug-in chargers are limited to 150-200 kW due to National Electric Code requirements for handheld wiring. Roof-mounted charging rails would allow a MT BEB to access higher power charging (200-600 kW) at the SBTC.

Figure 5-3. Inverted Pantograph and Charge Rails

FUEL CELL ELECTRIC BUS

Currently, there are no manufacturers in the U.S. market that offer a FCEB cutaway, deeming hydrogen power infeasible, under existing conditions. While a hydrogen-powered cutaway may be developed in the future, NAT must plan and design for facilities and buses that are currently on the market to ensure they can comply with CARB's ICT regulation. However, as technology further develops, NAT will remain open to technologies outside of BEB and will update plans, studies, and strategies, accordingly.

For specific blocks that are not capable of being served efficiently by existing BEB technology, FCEBs could be a viable option, if cutaways are eventually introduced to the market. In that case, it is recommended that hydrogen fuel cell vehicles be utilized and fueled either via future commercial/public hydrogen fueling stations located near the SBTC. As no fueling operations currently exist on MT's sites, it is not recommended to introduce on-site hydrogen fueling.

5.2.3 EXISTING ZEB PROCUREMENTS AND PROJECTS

MT is currently working with Michelle Kirkhoff Consulting, LLC (MKC) in their master planning efforts to adopt ZEBs.

5.2.4 PROCUREMENT SCHEDULE

In accordance with the ICT regulation, MT will prioritize ZEB purchases and progressively increase the percentage of ZEB purchases over time. Based on initial analysis, the last conventional bus is expected to be purchased in 2028. All new buses purchases are anticipated to be ZEB starting in 2030 (no procurements in 2029).

Early retirement should not be an issue pursuant to the ICT regulation based on MT's assumed procurement schedule. However, if it becomes one, MT will deploy a number of strategies to ensure that buses fulfill their "useful life". One potential strategy is to place newly acquired buses on MT's longest (distance) blocks of service. This will ensure that these buses meet their distance-based useful life requirement more rapidly.

MT's existing fleet consists of 19 cutaway buses. Assuming a 1:1 replacement ratio, each existing bus will eventually be replaced with an equivalent-length BEB cutaway bus. However, the number of ZEBs required may increase with time based on service requirements.

Table 5-2 presents a summary of MT's anticipated bus procurements through 2040. Years 2026 and 2029 are highlighted because these indicate when MT's new purchases should be 25 percent and 100 percent ZEBs, respectively.

Table 5-2. Summary of MT's Future Bus Purchases (through 2040)

		ZERO-EMISSION BUSES				CONVENTIONAL (CNG) BUSES			
YEAR	TOTAL BUSES	NUMBER	PCT.	BUS TYPE	FUEL TYPE	NUMBER	PCT.	BUS TYPE	FUEL TYPE
2020	**4**	0	0%	-	-	4	100%	Cutaway	Diesel
2021	**8**	0	0%	-	-	8	100%	Cutaway	Diesel
2022	**0**	0	0%	-	-	0	0%	-	-
2023	**7**	0	0%	-	-	7	100%	Cutaway	Diesel
2024	**0**	0	0%	-	-	0	0%	-	-
2025	**4**	0	0%	-	-	4	100%	Cutaway	Diesel
2026	**8**	2	25%	Cutaway	BEB	6	75%	Cutaway	Diesel
2027	**0**	0	0%	-	-	0	0%	-	-
2028	**7**	1	25%	Cutaway	BEB	6	75%	Cutaway	Diesel
2029	**0**	0	0%	-	-	0	0%	-	-
2030	**4**	4	100%	Cutaway	BEB	0	0%	-	-
2031	**8**	8	100%	Cutaway	BEB	0	0%	-	-
2032	**0**	0	0%	-	-	0	0%	-	-
2033	**7**	7	100%	Cutaway	BEB	0	0%	-	-
2034	**0**	0	0%	-	-	0	0%	-	-
2035	**4**	4	100%	Cutaway	BEB	0	0%	-	-
2036	**8**	8	100%	Cutaway	BEB	0	0%	-	-
2037	**0**	0	0%	-	-	0	0%	-	-
2038	**7**	7	100%	Cutaway	BEB	0	0%	-	-
2039	**0**	0	0%	-	-	0	0%	-	-
2040	**4**	4	100%	Cutaway	BEB	0	0%	-	-

Note: All procurements are based on a useful basic life of five years.
Source: WSP, February 2020

5.2.5 ZEB RANGE REQUIREMENTS AND COSTS

MT operates 11 blocks during weekdays, eight of which are longer than 100 miles. MT's longest blocks are approximately 275 miles. Depending on operational parameters, including operator behavior, ambient temperature, traffic, and ridership, these ranges may be unattainable or difficult to achieve on certain days. To reduce impacts to service, MT will consider a number of strategies to supplement onboard battery storage, including additional buses, midday charging, battery/charging management systems, and solar and battery storage. In future ZEB applications, MT may also consider FCEBs, especially if battery technology doesn't advance as forecasted. Table 5-3 presents the required range and estimated cost of ZEBs through 2040.

Table 5-3. Range and Estimated Costs of Future ZEB Purchases

YEAR	TOTAL ZEBS	BUS TYPES	REQUIRED RANGE (MI.)	ESTIMATED COST/BUS
2026	**8**	BEB	160	
2028	**7**	BEB	180	
2030	**4**	BEB	200	
2031	**8**	BEB	210	
2033	**7**	BEB	230	
2035	**4**	BEB	250	
2036	**8**	BEB	260	
2038	**7**	BEB	280	
2040	**4**	BEB	300	

Source : WSP, February 2020

5.2.6 ZEB CONVERSIONS

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

5.3 FACILITIES AND INFRASTRUCTURE MODIFICATIONS

The following sections detail the planned charging strategies, infrastructure, detailed base improvements, and program schedule.

5.3.1 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. For that reason, the recommended facility and infrastructure modifications are based on what can physically be accommodated at each facility. This is based on the number of existing vehicles plus a predetermined growth factor (or space at the division). This provides the agency with a ceiling for what can physically be constructed and at what cost. Service changes and bus movements may happen multiple times a year, for some agencies. By establishing a full build scenario, agencies can optimize, and tailor strategies based on existing (or anticipated) service for implementation.

The analysis of FCEBs at each agency is ongoing, however, a hydrogen storage footprint was established at each division where vehicles and space can support it. Further analysis (Master Plan and subsequent studies) will analyze alternatives of hydrogen delivery.

In the case of MT, the full build scenario is presented for context. However, refinements and tailored strategies will be developed in the Master Plan and future implementation studies.

5.3.2 FACILITY MODIFICATIONS

MT's transition to ZE technologies, namely, BEB, will require a number of modifications and changes to existing infrastructure and operations. This would include the enhancements and expansions of electrical equipment, additional electrical capacity, and the installation of BEB chargers, dispensers, and other components. These modifications will occur at MT's two existing bases in Crestline and Big Bear Lake, and a future base that is currently under construction in Crestline (across the street from the existing Crestline base).

Based on MT's existing service needs and site configurations, MT plans on installing ground-mounted plug-in chargers to support BEBs at all three bases. The proposed full facility layout is based on utilizing a 150-kW DC charging cabinet used in a 1:2 charging ratio (one DC charging cabinet energizes two separate plug-in cord dispensers). This charger to dispenser ratio would meet the requirements to charge MT's fleet during the vehicles' servicing and dwell time on the site while minimizing the peak electrical demand.

Figure 5-4 illustrates the location of MT's bases and

Table 5-4 summarizes the modifications and schedule of each base and the following sections detail the process of each base's transition from existing conditions to BEB-readiness.

Figure 5-4. MT's Base Locations

Table 5-4. MT's Base Summary

GARAGE	ADDRESS	MAIN FUNCTIONS	PLANNED INFRASTRUCTURE	EXISTING/REQ'D CAPACITY (MW)	UPGRADES REQ'D?	TIMELINE
Crestline	621 Forest Shade Rd. Crestline, CA	Storage, and Maintenance	Plug-In Charging to support eight buses by 2025	5 MW	Yes	2023-2028

GARAGE	ADDRESS	MAIN FUNCTIONS	PLANNED INFRASTRUCTURE	EXISTING/REQ'D CAPACITY (MW)	UPGRADES REQ'D?	TIMELINE
Big Bear Lake	41939 Fox Farm Rd. Big Bear Lake, CA	Fueling and Storage	Plug-In Charging to support 14 buses by 2025	5 MW	Yes	2023-2028
Crestline (Future)	24042 Pioneer Camp Rd. Crestline, CA	Storage	Plug-In Charging to support four buses by 2025	5 MW	Yes	2023-2028

Source: WSP, February 2020

CRESTLINE BASE

EXISTING CONDITIONS

Crestline Base is located at 621 Forest Shade Road in the Crestline community of San Bernardino County. The base has an existing electrical capacity of XX MW with electrical service provided by SCE.

Currently, eight diesel-powered buses are stored, maintained, and serviced at the division. The Crestline site consists of the following separate structures and major site areas: bus parking, vehicle maintenance facility, and transportation and administration building. Buses enter from Forest Shade Road and are parked one-deep in angled tracks in the yard along the northern fence line. Buses are pulled nose-first into the spaces and must perform a complex backing procedure to exit the spaces and turn around for pull-out. On pull-out, buses exit the site for service onto Forest Shade Road. Buses are fueled and washed off-site due to no facilities being available on the site. The current base is extremely limited in extra space to install either ground-mounted, overhead electrical charging equipment, or hydrogen storage infrastructure.

Figure 5-5. Crestline Base - Existing Conditions

Source: Google Earth, February 2020

Figure 5-6. Crestline Base's Maintenance Facility

Source: WSP, February 2020

Figure 5-7. Crestline Base's Parking

Source: WSP, February 2020

PLANNED ZEB MODIFICATIONS

Based on the recommended ground-mounted DC plug-in charging solution, the Crestline base is capable of parking eight buses with eight plug-in charging positions in a 1:2 charger to bus dispenser ratio.

Table 5-5 summarizes the ZEB infrastructure planned at the Crestline Base.

Table 5-5. Crestline Base Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY*
MT	Crestline	Ground-Mounted; Plug-In	4	8	150 kW	N/A

Source: WSP, February 2020

Note: At this time, there are no current cutaway FCEBs on the market, however, if one is developed and MT determines adoption is feasible, on-site fueling/storage is recommended.

The following BEB equipment and locations are proposed:

— Four charging cabinets in the northwest portion of the yard adjacent to the existing bus parking with eight plug-in dispenser charging positions along the northern yard wall in the existing parking layout. Buses will be connected to the dispenser via a charging point located on the front of the bus.

The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

— One medium voltage utility service transformer in a new utility yard in the open space west of the existing parking spaces and east of the site entrance.

— One switchgear in a new utility yard in the open space west of the existing parking spaces and east of the site entrance.

MT does not currently perform any on-site fueling, and no space is available within the existing Crestline site. The facility is also near residential properties which restricts on-site hydrogen fueling options.

Figure 5-8 illustrates the Crestline base at full build-out.

Figure 5-8. Crestline Base – Full ZEB Build-Out

Source: WSP, February 2020

BIG BEAR LAKE BASE

EXISTING CONDITIONS

Big Bear Lake base is located at 41939 Fox Farm Road in the City of Big Bear Lake. The base has an existing electrical capacity of XX MW with electrical service provided by the Bear Valley Electric Service Utility.

Currently, 14 diesel-powered buses are stored and serviced at the division. The Big Bear base consists of the following separate structures and major site areas: bus parking, employee parking, and a joint vehicle maintenance and transportation building. Buses enter from Fox Farm Road, circulate counterclockwise, and are parked one-deep in angled tracks along the eastern and western fence lines. Buses are backed into their spaces. Buses are fueled and washed off-site due to no facilities being available on-site.

The current base appears to have adequate space for either ground-mounted or overhead charging equipment without major disruptions to operations or current capacity. There is neither liquid or gaseous fuel currently on site and spatial constraints would permit installation of hydrogen fuel storage or production.

Figure 5-9. Big Bear Lake Base - Existing Conditions

Source: Google Earth, February 2020

Figure 5-10. Big Bear Lake Base's Maintenance Facility

Source: WSP, February 2020

Figure 5-11. Big Bear Lake Base's Parking

Source: WSP, February 2020

PLANNED ZEB MODIFICATIONS

Based on the recommended ground-mounted DC plug-in charging solution, the Big Bear Lake base is capable of parking 14 buses with 14 plug-in charging positions in a 1:2 charger to bus dispenser ratio. All vehicles will continue to back into their parking stalls and be charged via the rear plug-in port.

Table 5-6 summarizes the ZEB infrastructure planned at the Big Bear Lake Base.

Table 5-6. Big Bear Lake Base Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY*
MT	Big Bear Lake	Ground-Mounted; Plug-In	7	14	150 kW	N/A

Source: WSP, February 2020
Note: At this time, there are no current cutaway FCEBs on the market, however, if one is developed and MT determines adoption is feasible, on-site fueling/storage is recommended.

The following BEB equipment and locations are proposed:

— Two charging cabinets with four plug-in dispenser charging positions along the northwest angled parking stalls in the yard edge.

— Two charging cabinets with four plug-in dispenser charging positions along the southwest angled parking stalls in the yard edge.

— One charging cabinet with two plug-in dispenser charging positions along the southwest straight parking stalls in the yard edge.

— Two charging cabinets with four plug-in dispenser charging positions along the northeast angled parking stalls in the yard edge.

— One charging cabinet with two plug-in dispenser charging positions along the southeast parking stalls in the yard edge.

The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

— One medium voltage utility service transformer in a new utility yard in the open space north of the existing parking spaces and along the eastern site boundary.

— One switchgear in a new utility yard in the open space north of the existing parking spaces and along the eastern site boundary.

MT does not currently perform any on-site fueling, and it is not recommended to add on-site fueling to the ongoing operations due to the difficulty of transporting hydrogen to the site at high altitude.

Figure 5-12 illustrates the Big Bear Lake Base at full build-out.

Figure 5-12. Big Bear Lake Base – Full ZEB Build-Out

Source: WSP, February 2020

CRESTLINE BASE (FUTURE)

EXISTING CONDITIONS

The future Crestline Base will be located at 621 Forest Shade Road in the Crestline community of San Bernardino County. The base has an existing electrical capacity of XX MW with electrical service provided by SCE.

The future base currently consists of a residential house, canopy covered driveway area, and backyard area. Drivers are currently using the existing residence as a restroom and relief area. Buses are currently parking both under the existing canopy and along the fence in the backyard area.

Buses enter from Pioneer Camp Road and are parked in the canopy covered area of the base, as well as the backyard portion of the property. There is no specific parking layout on-site.

The base appears to have space to install either ground-mounted or overhead electrical charging equipment depending on the final layout. Hydrogen storage and fueling is not feasible for inclusion at this future site due to spatial constraints and surrounding residential zoning.

Figure 5-13. Crestline Base (Future) - Existing Conditions

Source: Google Earth, February 2020

Figure 5-14. Crestline Base (Future) – Existing Conditions

Source: WSP, February 2020

PLANNED ZEB MODIFICATIONS

Based on the recommended ground-mounted DC plug-in charging solution, the Crestline Base (future) is capable of parking eight buses with eight plug-in charging positions in a 1:2 charger to bus dispenser ratio.

Table 5-7 summarizes the ZEB infrastructure planned at the Crestline Base (Future).

Table 5-7. Crestline Base (Future) Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY*
MT	Crestline (Future)	Ground-Mounted; Plug-In	4	8	150 kW	N/A

Source: WSP, February 2020
Note: At this time, there are no current cutaway FCEBs on the market, however, if one is developed and MT determines adoption is feasible, on-site fueling/storage is recommended.

The following BEB equipment and locations are proposed:

— Two charging cabinets with four plug-in dispenser charging positions along the northwestern yard edge.

— Two charging cabinets along the northeastern yard edge with four plug-in dispenser charging positions. Two positions are along the northern yard wall and two are located between bus parking and the eastern yard edge. Buses will be connected to the dispenser via a charging point located on the front of the bus.

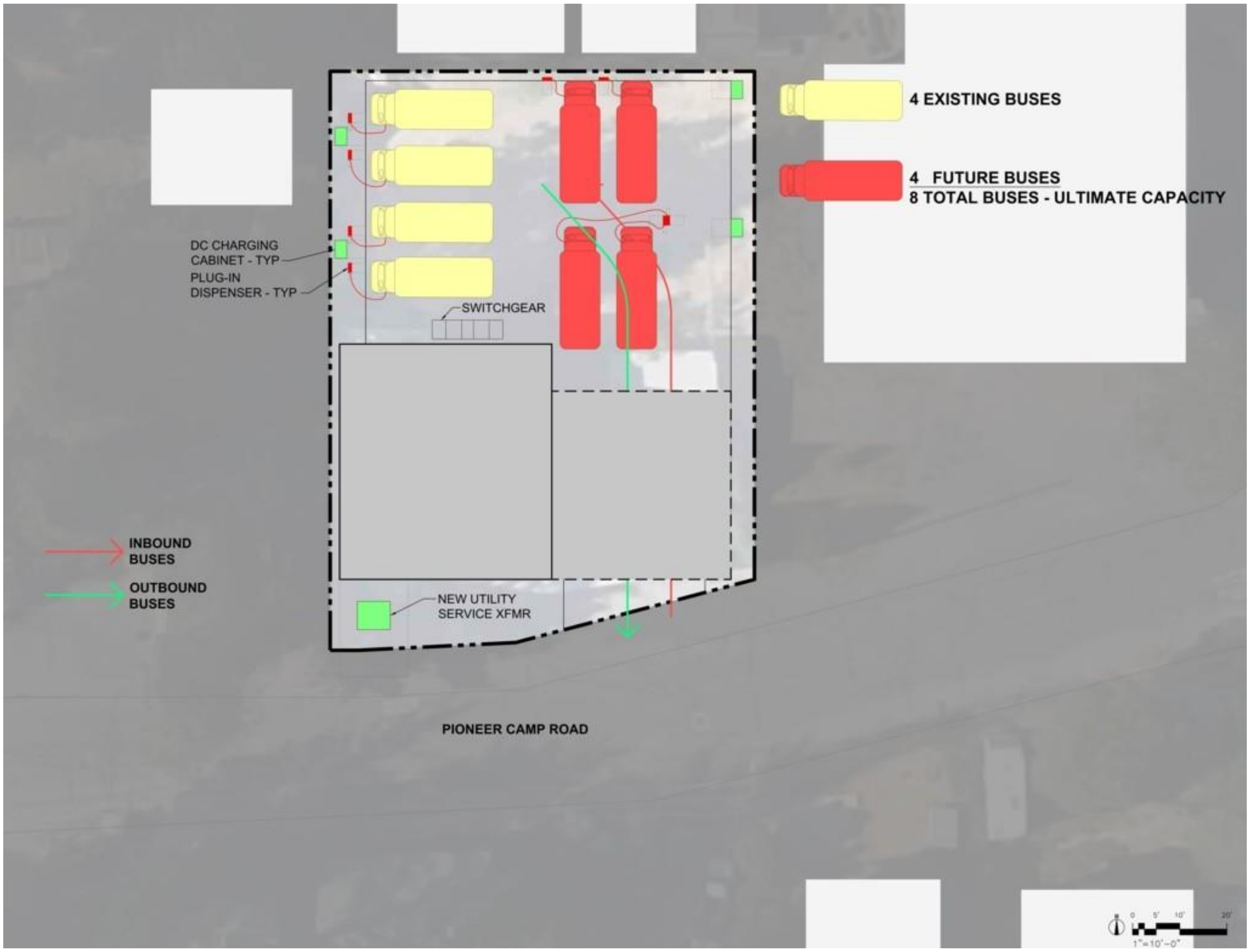
The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

— One medium voltage utility service transformer in front of the existing residential building with street access from Pioneer Camp Road.

— One switchgear north of the existing residential building.

Figure 5-15 illustrates the Crestline Base (future) at full build-out.

Figure 5-15. Crestline Base (Future) – Full ZEB Build-Out



Source: WSP, February 2020

5.3.3 PHASING AND CONSTRUCTION SCHEDULE

Adhering to the construction schedule and milestones will be critical because the facilities' construction must be completed before buses are delivered, otherwise, the buses will not be able to operate. To accomplish this, construction for BEB-supporting infrastructure is expected to be done in phases to minimize disruption of operations. Big Bear Lake Base is expected to be completed in two phases, and the Crestline Bases are expected to be completed in one.

Additional electrical capacity will be required to meet the service needs of buses at all bases. Construction and enhancements to bring this additional electrical capacity is anticipated to take three to five years based on electrical utilities' protocol. This timeframe would include method of service studies, design, and construction. It is recommended that electrical infrastructure such as transformers and switchgears be installed with the initial phase at Crestline and Big Bear Lake bases to avoid the disruption of ongoing charging operations.

The following provides details on recommended phasing for each yard.

CRESTLINE BASE

PHASE 1

The plan for the Crestline site is to install all of the electrical distribution in above-ground conduit along the northern existing site wall to route electrical service to all four charging cabinets with eight plug-in dispensers mounted at the edge of the parking spaces on the northern boundary of the yard. These chargers and dispensers can be installed without trenching the existing yard.

BIG BEAR LAKE BASE

PHASE 1

The recommended first phase of charger installation the for the Big Bear Lake site is to install all of the in-ground conduit to route electrical service to three charging cabinets with six plug-in dispensers mounted at the edge of the parking spaces on the eastern boundary of the yard. These chargers and dispensers can be installed without any trenching modification to the existing parking areas.

PHASE 2

Phase 2 of charger installation for the Big Bear Lake site is to install all of the in-ground conduit to route electrical service to five additional charging cabinets with 10 plug-in dispensers mounted at the edge of the parking spaces on the western boundary of the yard. These chargers and dispensers can be installed without any trenching modification to the existing parking areas.

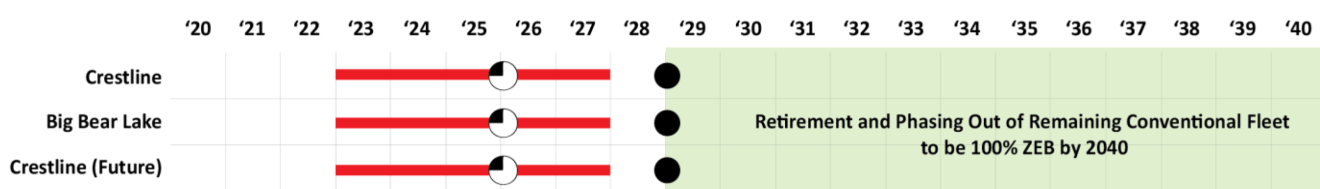
CRESTLINE BASE (FUTURE)

PHASE 1

The plan for the future Crestline site is to install all of the in-ground conduit to route electrical service to all four charging cabinets on both the east and west yard edges with eight plug-in dispensers split between mounting at the east and west edges edge of the existing yard. As this parking area is not currently paved, it is recommended to complete all BEB charger and infrastructure equipment at the same time as paving the yard. No concrete trenching will be required, and cost savings will be gained by installing the chargers simultaneous to developing the yard.

Figure 5-16 presents the proposed construction schedule for MT's transition to ZEBs. The Harvey Balls indicate the percentage of new buses that need to be ZEB.

Figure 5-16. MT Construction Schedule



Source : WSP, February 2020

5.4 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, as 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.

5.4.1 MT'S DISADVANTAGED COMMUNITY ANALYSIS

To understand ZEBs impacts on MT's service area, it was pertinent to establish if: 1) its yards are in a DAC; and 2) if its routes traverse DACs.

At this time, neither the Crestline nor Big Bear Lake bases are located in areas considered "disadvantaged". However, both bases serve routes that traverse DACs. Crestline serves 24 communities, 14 of which (58 percent), are considered disadvantaged. Whereas, Big Bear Lake serves 34 communities, 17 of which (50 percent), are considered disadvantaged.

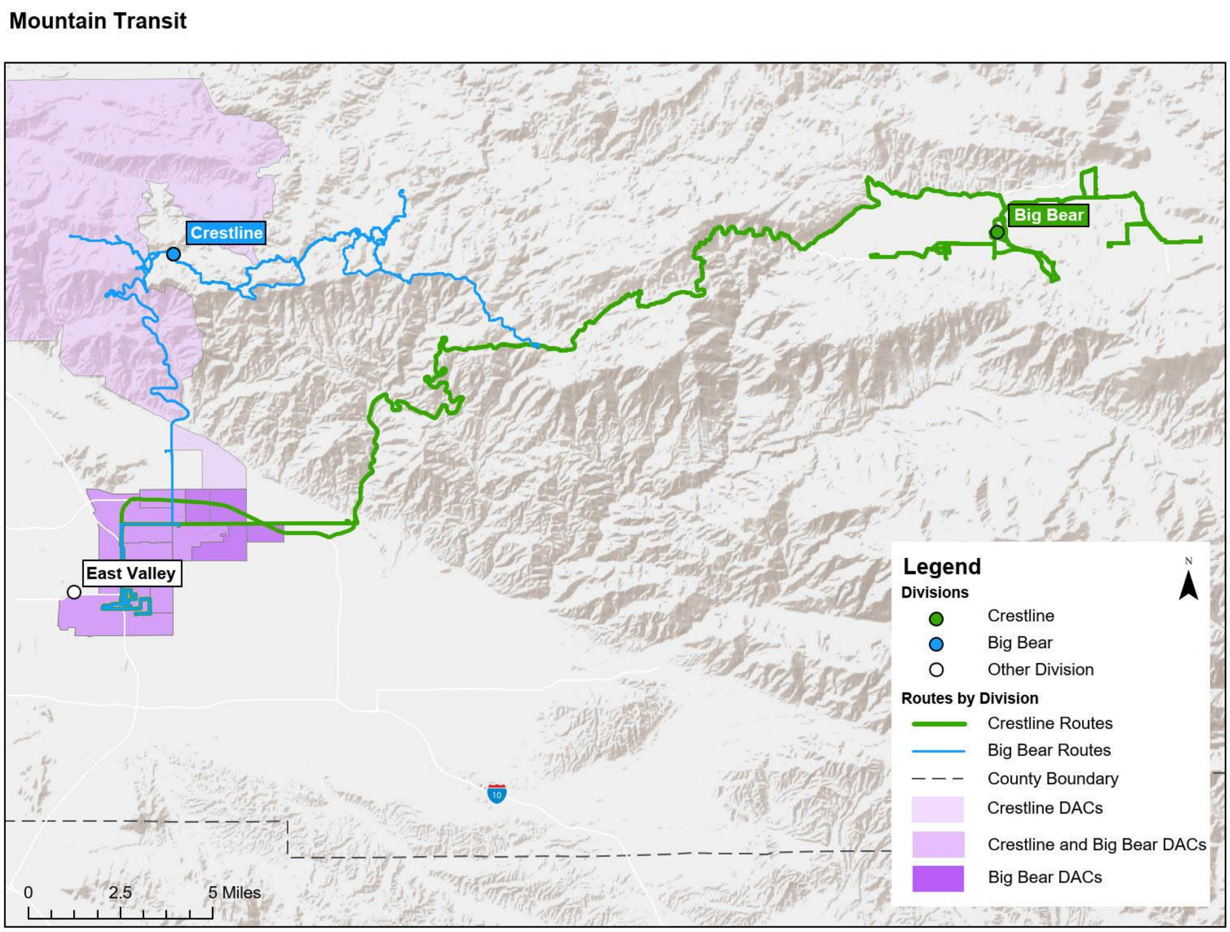
Table 5-8 summarizes MT's bases and census tracts served in terms of DACs. Figure 5-17 illustrates MT's bases and the census tracts that they serve.

Table 5-8. MBTA's Disadvantaged Communities

BASE	IN DAC?	NOX EXEMPT AREA?	COMMUNITIES SERVED	DAC'S SERVED	PCT. OF DACS SERVED
Crestline	No	Yes	24	14	58%
Big Bear Lake	No	Yes	34	17	50%
Crestline Future	No	Yes	TBD	TBD	TBD

Source : CalEnviroScreen 3.0, February 2020

Figure 5-17. MT's Disadvantaged Communities



Source : CalEnviroScreen 3.0, February 2020

5.5 WORKFORCE TRAINING

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

5.5.1 TRAINING REQUIREMENTS

The transition to ZEBs will significantly alter MT's service and operations. Converting to ZEBs from diesel is an arduous endeavor and will impact all ranks of the organization. This will require extensive change management and training, some of which will be provided by the OEMs, others by MT and outside organizations. Training will need to be conducted well in advance of the delivery of the first buses and will be ongoing throughout the lifecycle of the technology.

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
Bus operators will need to be familiarized with the buses, safety, bus operations, and pantograph operations.

— Facilities Maintenance Staff and Maintenance
Facilities 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.

— Body Repairers
Body repairers will need to be familiarized with the safety-related features and other components of ZEBs.

— Instructors
Instructors will need to understand all aspects of the transition of ZEBs to train others.

— Service Attendants
Service attendants will become familiarized with proper charging protocol and procedures that are ZEB-specific.

— Management Staff
All Management (supervisors, directors, etc.) will be familiarized with ZEB operations and safety procedures.

Table 5-9: MT's ZEB Training Summary

TRAINING PROGRAM/ CLASS	PURPOSE OF TRAINING	NAME OF PROVIDER	NUMBER OF TRAINEES	TRAINEES' POSITIONS	TRAINING HOURS	TRAINING FREQUENCY	ESTIMATED COSTS PER CLASS

Source : WSP, February 2020

5.6 COSTS AND FUNDING

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

5.6.1 PRELIMINARY COSTS

As expected, the cost of ZEB adoption is going to be very expensive. While actual costs (capital and operations & maintenance) of the transition are still being determined and evaluated, it is assumed that a full transition for just the buses and chargers (based on existing conditions) will cost approximately $12.4 million (in 2020 dollars). This assumes of approximately $100K and $50k for charging equipment (DC cabinets and dispensers) and support equipment (conduit, trenching, cabling, etc.), respectively, per bus. This also includes an assumed cost of $500K per bus, however, this will vary depending on length, customizations, etc.

5.6.2 POTENTIAL FUNDING SOURCES

There are a number of potential federal, state, local, and project-specific funding and financing sources at MT's disposal. MT will monitor funding cycles and pursue opportunities that yield the most benefits for the agency pursuant to the ICT regulation. The following table identifies the many funding opportunities that MT may take advantage of in the next 20 years.

Table 5-10. MT ZEB 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
	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

TYPE	AGENCY	FUNDING MECHANISM
		Opportunity Zones

Source : WSP, February 202

5.7 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 MT has identified. The following sections briefly describe some of the challenges that MT faces for its transition.

— **Uncertainty of ZEB cutaways.** As discussed, there is a small market for ZEB cutaways. For the cutaways that do exist, there is uncertainty in their product range and if they're Altoona-tested. Unfortunately, the cutaway market does not currently offer FCEBs, so MT has no other alternative and will need to plan for BEB adoption.

— **Operating conditions.** MT's fleet currently climbs altitudes and operates in weather conditions that aren't typical of the region. These conditions have a huge impact on range, meaning, MT would have to invest more than other agencies to operate similar bus blocks (in terms of range).

— **Range issues.** MT has some blocks that exceed current BEB range. This means that MT will have to consider the following strategies to reduce or avoid service disruptions:

  — **Buy more buses.** This can assist with service requirements; however, more buses will require more chargers, more space at the division, and potentially higher utility costs.

  — **Opportunity charging.** This strategy could potentially reduce the costs (per bus) due to a smaller battery requirement, however, it would result in more capital infrastructure and utility costs.

  — **Service changes.** This would require the manipulation of block structure. While the riders may not notice the change, the agency will have to consider the potential impacts to operator and maintenance costs.

— **Technological adaptation.** Currently, MT is modeling and planning for a transition based on existing service and ZEB technology. With the 2040 deadline looming, it is difficult to anticipate future technological enhancements and changes, such as improved batteries and chargers. Slight changes in these technologies could improve bus ranges, in turn, reducing costs. MT (and the market) has to be aware of these changes as it would be counterproductive to invest in technologies that will soon be outdated.

— **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. MT 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.

— **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, however, it will also make it challenging to meet ZEB goals for agencies if supply of buses can meet with demand.

6 CITY OF NEEDLES

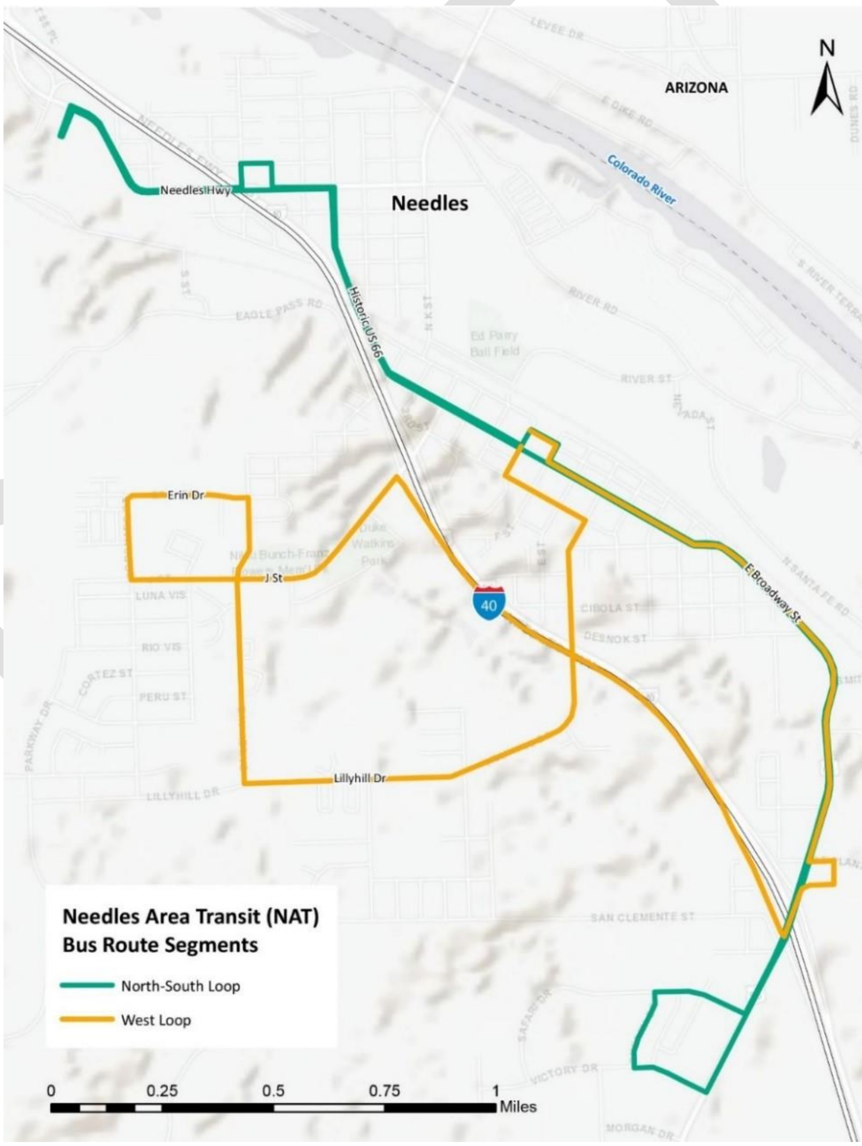
6.1 INTRODUCTION

The City of Needles operates Needles Area Transit (NAT), a service that provides fixed-route transportation within the City of Needles (the sections below will refer to the City of Needles as both Needles and the City).

6.1.1 SERVICE AREA

NAT serves the City of Needles, which rests along the Colorado River and the Arizona and Nevada borders at the eastern edge of San Bernardino County. Its population according to the 2010 United States Census was 4,984.

Figure 6-1. NAT Service Area



Source: WSP

6.1.2 ENVIRONMENTAL FACTORS

Relative to the other communities that SBCTA-affiliated transit operators serve, the City of Needles is extraordinarily isolated. The nearest city within San Bernardino County is Barstow, over 140 miles away across the Mojave Desert and two mountain ranges; the nearest large city is Las Vegas, Nevada, approximately 110 miles away.

Needles experiences a desert climate, with average high temperatures of 108 degrees in July. Average temperatures are lowest in December and January, 43 and 44 degrees, respectively. The city receives very little precipitation, with annual rainfall amounting to 4.65 inches[4].

6.1.3 SCHEDULE AND OPERATIONS

NAT operates deviated fixed-route service on a single route within the city, which runs weekdays from 7:00 AM to 6:55 PM and Saturdays from 10:00 AM to 4:55 PM. The City of Needles also operates a dial-a-ride service for seniors and disabled passengers, and medical transportation to Mohave Valley/Bullhead City on Tuesdays and Thursdays, and a Shopper Shuttle on Wednesdays to Fort Mohave (with advanced reservation).

The single fixed route is a combination of two loops, each with a 25-minute duration. The east-west loop begins on the hour and serves several civic destinations and the Colorado River Medical Center. The north-south loop begins on each half-hour and travels along historic Route 66, serving the Needles town center.

6.2 FLEET AND ACQUISITIONS

The following section provides an overview of NAT's existing fleet, planned purchases, and description of how NAT will meet the requirements of the ICT regulation.

6.2.1 EXISTING BUS FLEET

As of October 2019, the City of Needles directly operates three diesel-powered, 25-foot, cutaway buses for fixed-route service. Table 6-1 presents a summary of NAT's fixed-route existing bus fleet.

Table 6-1. Summary of NAT's Existing Bus Fleet

MANUFACTURER	SERIES	FUEL TYPE	LENGTH	IN SERVICE YEAR	BUS TYPE	NO. OF BUSES
Glaval Express	4500	Diesel	25'	2018	Cutaway	2
Elkhart Coach	Type C	Diesel	25'	2012	Cutaway	1
					Total Buses	**3**

Source: City of Needles, October 2019

6.2.2 ZEB TECHNOLOGY APPLICATION

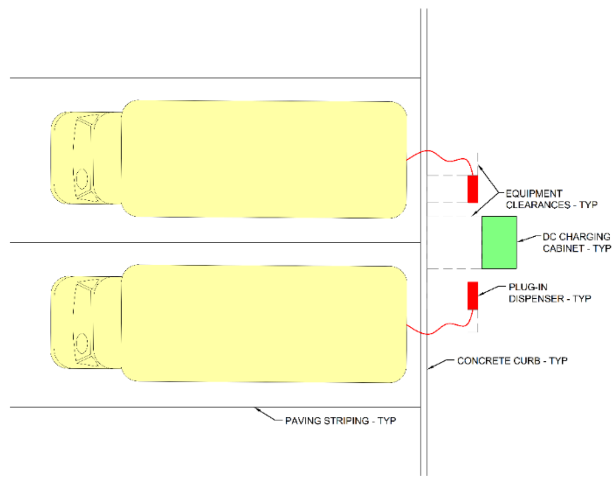
Past and ongoing ZEB analysis for NAT's operations has determined that BEB adoption is the ZEB technology that suits the needs of Needles for their purchasing and transition requirements pursuant to the ICT regulation. FCEBs, at this time, are not feasible due to no current manufacturers offering a cutaway.

[4] U.S. Climate data; Needles, CA, 2019 https://www.usclimatedata.com/climate/needles/california/united-states/usca0753

BATTERY-ELECTRIC BUS

NAT's future BEBs are expected to have specifications that are compatible with the SAE J1772 charging standard (e.g., "plug-in charging") (Figure 6-2). It is recommended that Needles specify charging ports on the rear of BEBs to allow for their existing site circulation and parking patterns to continue without additional modifications. Battery sizing (kilowatts) will be determined based on service needs requirements and what is available and feasible based on costs and weight. Charger rating (kilowatt-hour) will be based on service needs, battery acceptance, and costs.

Figure 6-2. Ground-Mounted Plug-In Charger



Source: WSP, February 2020

FUEL CELL ELECTRIC BUS

Currently, there are no manufacturers in the U.S. market that offer a FCEB cutaway, deeming hydrogen power infeasible, under existing conditions. While a hydrogen-powered cutaway may be developed in the future, Needles must plan and design for facilities and buses that are currently on the market to ensure they can comply with CARB's ICT regulation. However, as technology further develops, the city will remain open to technologies outside of BEB and will update plans, studies, and strategies, accordingly.

For specific blocks that are not capable of being served efficiently by existing BEB technology, FCEBs could be a viable option, if cutaways are eventually introduced to the market. In that case, it is recommended that FCEBs be fueled at future commercial/public hydrogen fueling stations located in the Needles service area. As no fueling operations currently exist at the garage nor does the existing site have enough open area to add a small modular hydrogen fueling system. It is not recommended to introduce on-site hydrogen fueling.

6.2.3 PROCUREMENT SCHEDULE

In accordance with the ICT regulation, the City of Needles will prioritize ZEB purchases and progressively increase the percentage of ZEB purchases over time. Based on initial analysis, the last conventional bus is expected to be purchased in 2023. All new buses purchases are anticipated to be ZEB starting in 2028 – one year before the requirement.

Early retirement should not be an issue pursuant to the ICT regulation based on Needles' assumed procurement schedule. However, if it becomes one, the City will deploy several strategies to ensure that buses fulfill their “useful life”. One potential strategy is to place newly acquired buses on NAT’s longest (distance) blocks of service. This will ensure that these buses meet their distance-based useful life requirement more rapidly.

NAT’s existing fleet consists of three 25-foot cutaway buses. Assuming a 1:1 replacement ratio, each existing bus will eventually be replaced with a 25-foot BEB cutaway bus. However, the number of ZEBs required may increase based on service requirements.

Table 6-2 presents a summary of NAT’s anticipated bus procurements through 2040. Years 2026 and 2029 are highlighted because these indicate when NAT’s new purchases should be 25 percent and 100 percent ZEBs, respectively.

Table 6-2. Summary of NAT’s Future Bus Purchases (through 2040)

		ZERO-EMISSION BUSES				CONVENTIONAL (CNG) BUSES			
YEAR	TOTAL BUSES	NUMBER	PCT.	BUS TYPE	FUEL TYPE	NUMBER	PCT.	BUS TYPE	FUEL TYPE
2020	**0**	0	0%	-	-	0	0%	-	-
2021	**0**	0	0%	-	-	0	0%	-	-
2022	**0**	0	0%	-	-	0	0%	-	-
2023	**1**	0	0%	-	-	1	100%	Cutaway	Diesel
2024	**0**	0	0%	-	-	0	0%	-	-
2025	**0**	0	0%	-	-	0	0%	-	-
2026	**0**	0	0%	-	BEB	0	0%	-	-
2027	**0**	0	0%	-	BEB	0	0%	-	-
2028	**1**	1	100%	Cutaway	BEB	0	0%	-	-
2029	**0**	0	0%	-	BEB	0	0%	-	-
2030	**0**	0	0%	-	BEB	0	0%	-	-
2031	**0**	0	0%	-	BEB	0	0%	-	-
2032	**0**	0	0%	-	BEB	0	0%	-	-
2033	**1**	1	100%	Cutaway	BEB	0	0%	-	-
2034	**0**	0	0%	-	BEB	0	0%	-	-
2035	**0**	0	0%	-	BEB	0	0%	-	-
2036	**0**	0	0%	-	BEB	0	0%	-	-
2037	**0**	0	0%	-	BEB	0	0%	-	-
2038	**1**	1	100%	Cutaway	BEB	0	0%	-	-
2039	**0**	0	0%	-	BEB	0	0%	-	-
2040	**0**	0	0%	-	BEB	0	0%	-	-

Note: All new purchases were assumed to have a useful life of five years per FTA Circular 9030.1D, Ch. VI, paragraph 4.a. NAT typically has two buses in service with a third classified as a spare. The spare, per this schedule, is kept for 10 years before replacement with the second oldest fleet vehicle. For example, in 2033, NAT will purchase a new BEB. Its 2028 bus will still be used in service and its 2023 bus will be used as a spare (2018 vehicle will be retired).
Source: WSP, February 2020

6.2.4 ZEB RANGE REQUIREMENTS AND COSTS

NAT operates two blocks. The first block (weekday) is approximately 166 miles with a duration of 10 hours. The second block (Saturday) is approximately 97 miles with a duration of six hours. Depending on operational parameters, including operator behavior, ambient temperature, traffic, and ridership, these ranges may be unattainable or difficult to achieve on certain days. To reduce impacts to service, the City will consider a number of strategies to supplement onboard battery storage, including additional buses, midday charging, battery/charging management systems, and solar and battery storage. In future ZEB applications, NAT may also consider FCEBs, especially if battery technology doesn't advance as forecasted. Table 6-3 presents the required range and estimated cost of ZEBs through 2040.

Table 6-3. Range and Estimated Costs of Future ZEB Purchases

YEAR	TOTAL ZEBS	BUS TYPES	REQUIRED RANGE (MI.)	ESTIMATED COST/BUS
2028	1	BEB	175	$1,000,000
2033	1	BEB	175	$1,000,000
2038	1	BEB	175	$1,000,000

Source : WSP, February 2020

6.2.5 ZEB CONVERSIONS

Conventional bus conversions to ZEB technologies are not currently being considered for Needles. However, the City will remain open to conversions if they are deemed financially feasible and align with goals to zero-emission bus adoption.

6.3 FACILITIES AND INFRASTRUCTURE MODIFICATIONS

The following sections detail the planned charging strategies, infrastructure, detailed garage improvements, and program schedule.

6.3.1 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. For that reason, the recommended facility and infrastructure modifications are based on what can physically be accommodated at each facility. This is based on the number of existing vehicles plus a predetermined growth factor (or space at the division). This provides the agency with a ceiling for what can be physically constructed and at what cost. Service changes and bus movements may happen multiple times a year. By establishing a full ZEB build out scenario, agencies can optimize, and tailor strategies based on existing (or anticipated) service for implementation.

The analysis of FCEBs is ongoing, however, a hydrogen storage footprint was established at each division where vehicles and space can support it. Further analysis (Master Plan and subsequent studies) will analyze alternatives of hydrogen delivery.

In the case of Needles, the full ZEB build scenario is presented for context. However, refinements and tailored strategies will be developed in the Master Plan and future implementation studies.

6.3.2 FACILITY MODIFICATIONS

NAT's transition to ZE technologies, namely, BEB, will require a number of modifications and changes to existing infrastructure and operations.

The proposed full facility ZEB layout is based on utilizing a 150-kW DC charging cabinet used in a 1:2 charging ratio (one DC charging cabinet energizes two separate plug-in cord dispensers). This charger to dispenser ratio would meet the requirements to charge NAT's fleet during the vehicles' servicing and dwell time on the site while minimizing the peak electrical demand.

Table 6-4 summarizes the modifications and schedule of the garage and the following sections detail the process of the transition from existing conditions to BEB-readiness.

Table 6-4. Needles Garage Summary

GARAGE	ADDRESS	MAIN FUNCTIONS	PLANNED INFRASTRUCTURE	EXISTING/REQ'D CAPACITY (MW)	UPGRADES REQ'D?	TIMELINE
NAT	1101 Front St. Needles, CA	Storage	Plug-In Charging to support four buses by 2028	600/.6	Yes	2023-2028

Note: Bus maintenance and fuel is conducted offsite
Source: WSP, February 2020

NEEDLES AREA TRANSIT GARAGE

EXISTING CONDITIONS

The NAT Garage is located at 1101 Front Street in the City of Needles. The garage has an existing electrical capacity of XX MW with electrical service provided by the Needles Power Utility Authority, a municipal utility.

Currently, three diesel-powered cutaway buses are stored at the garage. Buses enter the driveway for both the garage and parking lot from Front Street and are stored in the three-bay garage for overnight parking. During extreme heat, bus drivers will leave their personal vehicles in the garage during operating hours to shelter vehicles from 120 °F heat. The garage is not equipped with HVAC, only lighting and three garage doors. General maintenance is currently performed off-site with the contract operator in Blythe, California, approximately 96 miles away.

Figure 6-3. NAT Garage - Existing Conditions

Source: Google Earth, February 2020

Figure 6-4. NAT Garage – Existing Conditions

Source: WSP, February 2020

PLANNED ZEB MODIFICATIONS

Based on Needles' existing service needs and site configuration, it is recommended that ground-mounted plug-in chargers be installed both internal and external to the NAT garage to support future BEBs.

Based on the recommended ground-mounted DC plug-in charging solution, the NAT garage is capable of parking four buses with two plug-in charging positions in a 1:2 charger to bus dispenser ratio.

Table 6-5 summarizes the ZEB infrastructure planned at NAT's facility.

Table 6-5. NAT ZEB Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY*
Needles	NAT	Ground-Mounted; Plug-In	2	4	150 kW	Off-Site Fueling

Source: WSP, February 2020
Note: At this time, there are no current cutaway FCEBs on the market, however, if one is developed and Needles determines adoption is feasible, on-site fueling/storage is recommended.

The following BEB equipment and location is proposed:

— Two charging cabinets along the western facility exterior and site boundary;

— Three plug-in dispenser charging positions along the western facility interior wall;

— One plug-in dispenser charging position on the northeastern existing facility exterior for exterior charging.

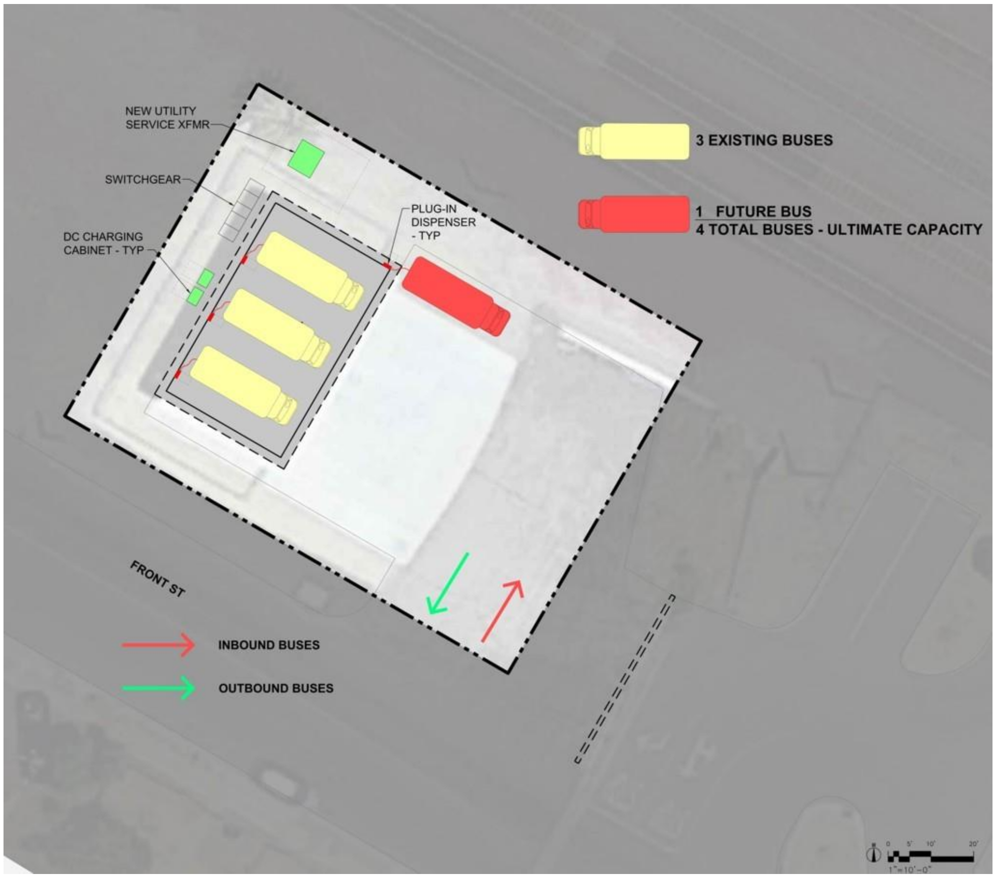
The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

— One medium voltage utility service transformer along the northwestern facility exterior and site boundary.

— One switchgear service along the western facility exterior and site boundary.

Figure 6-5 illustrates the NAT Garage at full build-out.

Figure 6-5. NAT Garage – Full ZEB Build-Out



Source: WSP, February 2020

6.3.3 PHASING AND CONSTRUCTION SCHEDULE

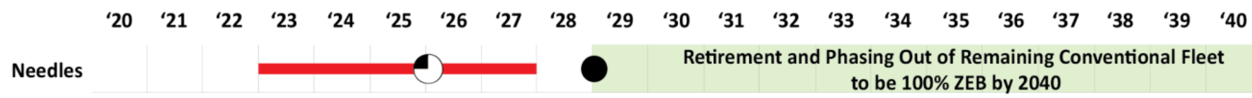
Adhering to the construction schedule and milestones will be critical because the facilities' construction must be completed before buses are delivered, otherwise, the buses will not be able to operate.

Additional electrical capacity will be required to meet the service needs of buses at the NAT garage. Construction and enhancements to bring this additional electrical capacity is anticipated to take three to five years. This timeframe would include method of service studies, design, and construction.

Construction for the NAT garage and its associated BEB charging equipment and support systems is assumed to be completed in one, six-month stage. The plan for the NAT garage is to install all of the in-ground conduit to route electrical service to both of the charging cabinets with four plug-in dispensers mounted at the edge of the parking spaces in the existing building and on its exterior wall. These chargers and dispensers can be installed with aboveground electrical distribution routed along a cable way from the new electrical yard to the western exterior wall to meet the charging cabinets. From the charging cabinets, the electrical distribution can then penetrate the wall to the interior dispensers and route along the interior wall before penetrating the wall to the exterior dispenser.

Figure 6-6 presents the proposed construction schedule for NAT's transition to ZEBs. The Harvey Balls indicate the percentage of new buses that need to be ZEB pursuant to the ICT regulation.

Figure 6-6. Needles Construction Schedule



Source: WSP, February 2020

6.4 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, as 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.

6.4.1 NAT'S DISADVANTAGED COMMUNITY ANALYSIS

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

At this time, the NAT garage is not in an area considered "disadvantaged". Its routes currently traverse two census tracts, both of which are not considered disadvantaged by the CalEnviroScreen tool.

Table 6-6 summarizes NAT's garages and census tracts serves in terms of DACs.

Table 6-6. NAT's Disadvantaged Communities

GARAGE	IN DAC?	NOX EXEMPT AREA?	COMMUNITIES SERVED	DAC'S SERVED	PCT. OF DACS SERVED
Needles Area Transit	No	Yes	2	0	0%

Source : CalEnviroScreen 3.0, February 2020

6.5 WORKFORCE TRAINING

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

6.5.1 TRAINING REQUIREMENTS

The transition to ZEBs will significantly alter NAT's service and operations. Converting to ZEBs from diesel is an arduous endeavor and will impact all ranks of the organization. This will require extensive change management and training, some of which will be provided by the OEMs, others by NAT and outside organizations. Training will need to be conducted well in advance of the delivery of the first buses and will be ongoing throughout the lifecycle of the technology.

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
Bus operators will need to be familiarized with the buses, safety, bus operations, and pantograph operations.

— Facilities Maintenance Staff and Maintenance
City 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.

— Body Repairers
Body repairers at the contracted operator will need to be familiarized with the safety-related features and other components of ZEBs.

— Instructors
Maintenance instructors will need to understand all aspects of the transition of ZEBs to train others.

— Service Attendants
Staff will become familiarized with proper charging protocol and procedures that are ZEB-specific.

— Management Staff
All Management will be familiarized with ZEB operations and safety procedures.

Table 6-7: NAT's ZEB Training Summary

TRAINING PROGRAM/CLASS	PURPOSE OF TRAINING	NAME OF PROVIDER	NUMBER OF TRAINEES	TRAINEES' POSITIONS	TRAINING HOURS	TRAINING FREQUENCY	ESTIMATED COSTS PER CLASS

6.6 COSTS AND FUNDING

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

6.6.1 PRELIMINARY COSTS

As expected, the cost of ZEB adoption is going to be very expensive. While actual costs (capital and operations & maintenance) of the transition are still being determined and evaluated, it is assumed that a full transition for just the buses and chargers (based on existing conditions) will cost approximately $1.95 million. This assumes of approximately $100K and $50k for charging equipment (DC cabinets and dispensers) and support equipment (conduit, trenching, cabling, etc.), respectively, per bus. This also includes an assumed cost of $500K per bus, however, this will vary depending on length, customizations, etc.

6.6.2 POTENTIAL FUNDING SOURCES

There are a number of potential Federal, State, local, and project-specific funding and financing sources at Needles' disposal. Needles will monitor funding cycles and pursue opportunities that yield the most benefits for the agency pursuant to the ICT regulation. The following table identifies the many funding opportunities that Needles may take advantage of in the next 20 years.

Table 6-8. NAT ZEB 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
	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

TYPE	AGENCY	FUNDING MECHANISM
		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

Source : WSP, February 2020

6.7 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 NAT has identified. The following sections briefly describe some of the challenges that NAT faces for its transition.

— **Uncertainty of ZEB cutaways.** As discussed, there is a small market for ZEB cutaways. For the cutaways that do exist, there is uncertainty in their product range and if they're Altoona-tested. Unfortunately, the cutaway market does not currently offer FCEBs, so NAT has no other alternative and will have to plan on BEB adoption.

— **Range issues.** NAT has some blocks that exceed current BEB range. This means that NAT will have to consider the following strategies to reduce or avoid service disruptions:

  — **Buy more buses.** This can assist with service requirements; however, more buses will require more chargers, more space at the division, and potentially higher utility costs.

  — **Opportunity charging.** This strategy could potentially reduce the costs (per bus) due to a smaller battery requirement, however, it would result in more capital infrastructure and utility costs.

  — **Service changes.** This would require the manipulation of block structure. While the riders may not notice the change, the agency will have to consider the potential impacts to operator and maintenance costs.

— **Technological adaptation.** Currently, NAT is modeling and planning for a transition based on existing service and ZEB technology. With the 2040 deadline looming, it is difficult to anticipate future technological enhancements and changes, such as improved batteries and chargers. Slight changes in these technologies could improve bus ranges, in turn, reducing costs. NAT (and the market) has to be aware of these changes as it would be counterproductive to invest in technologies that will soon be outdated.

— **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. NAT 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.

— **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, however, it will also make it challenging to meet ZEB goals for agencies if supply of buses can meet with demand.

7 OMNITRANS

7.1 INTRODUCTION

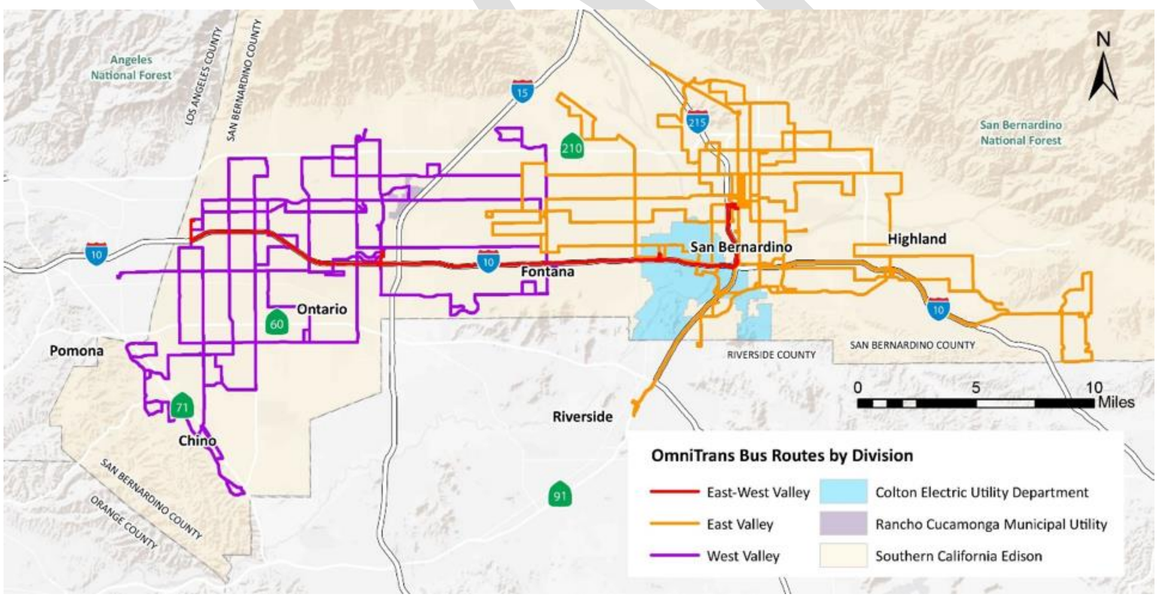
Omnitrans is the largest and highest-ridership transit operator in San Bernardino County. Omnitrans was established in 1976 through a joint powers agreement, which now includes 15 cities and unincorporated parts of the county.

7.1.1 SERVICE AREA

Omnitrans serves the urbanized area in and around the City of San Bernardino, south of the San Bernardino Mountains, which has a population of approximately 210,000. Other cities where Omnitrans operates are: Chino, Chino Hills, Colton, Fontana, Grand Terrace, Highland, Loma Linda, Montclair, Ontario, Redlands, Rialto, Upland, Rancho Cucamonga, and Yucaipa. The service area includes Ontario and San Bernardino airports, several Metrolink and Amtrak stations, as well as connections to several other regional bus transit authorities: Foothill Transit, Riverside Transit Authority, VVTA, and Pass Transit in Beaumont and Banning.

Omnitrans' service is organized into two divisions: East Valley Division, which serves Ontario, Rancho Cucamonga, and the surrounding cities and areas; and West Valley Division, which serves the areas in and around the City of San Bernardino. There also are two smaller division locations that Omnitrans currently uses primarily for paratransit vehicles.

Figure 7-1. Omnitrans Service Area



Source: WSP, February 2020

7.1.2 ENVIRONMENTAL FACTORS

The City of San Bernardino metropolitan area is typical of Southern California in terms of environmental conditions. With a hot-summer Mediterranean climate, average high temperatures peak in August at 80 degrees; December is the coldest average month with a 41- degree average low. During the fall, the region is particularly affected by the Santa Ana winds, bringing higher temperatures and increased risk of wildfires.

7.1.3 SCHEDULE AND OPERATIONS

Omnitrans operates 32 bus routes across four types of service: standard intercity routes, bus rapid transit (BRT), freeway express, and local shuttles. Routes in Omnitrans' system connect at several transit centers, which are off-street facilities, and transfer centers, which are on-street stops. The transit centers are: SBTC, Chaffey College, Chino, Fontana Metrolink, Montclair, Pomona, and Downtown Riverside and Riverside Metrolink.

Shown here by community, Omnitrans operates the following 32 routes:

- Bloomington: 19, 29
- Chino: 81, 83, 84, 85, 88, OmniGo 365
- Chino Hills: 88, OmniGo 365
- Colton: 1, 15, 19, 22, 215, 290
- Fontana: 10, 14, 15, 19, 20, 29, 61, 66, 67, 82
- Grand Terrace: OmniGo 325
- Highland: 3 & 4, 15
- Loma Linda: sbX Green Line, 2, 8, 19, OmniGo 325
- Mentone: 8
- Montclair: 66, 85, 88, 290
- Ontario: 61, 80, 81, 82, 83, 86, 290
- Pomona: 61
- Rancho Cucamonga: 61, 66, 67, 80, 81, 82, 85
- Redlands: 8, 15, 19, 208
- Rialto: 10, 14, 15, 19, 22
- San Bernardino: sbX Green Line, 1, 2, 3 & 4, 5, 7, 8, 10, 11, 14, 15, 208, 215, 290
- Upland: 66, 83, 84, 85
- Yucaipa: 8, 19, 208, OmniGo 308/309/310

The vast majority of Omnitrans' routes operate daily. Most routes operate with limited service on Saturday, and service is further limited on Sundays. All but two standard routes operate on Saturday; a select few do not operate on Sunday.

All single- and double-digit routes are standard intercity routes. These routes range from seven to 30 miles in route length. Its BRT service is the sbX Green Line, which travels along the E Street Corridor between Cal State University San Bernardino and Loma Linda University and Medical Center. Five of the sbX Green Line's 16 miles are in dedicated bus lanes. The 200-level routes are freeway express routes, serving the I-10 and I-215 corridors with limited stops; these routes are also generally longer than the intercity routes. Lastly, the 300-level routes are OmniGo shuttles, which use smaller vehicles to travel short, circular routes in the communities of Yucaipa, Grand Terrace, and Chino Hills.

7.2 FLEET AND ACQUISITIONS

The following section provides an overview of Omnitrans' existing fleet, planned purchases, and description of how Omnitrans will meet the requirements of the ICT regulation.

7.2.1 EXISTING BUS FLEET

As of July 2019, Omnitrans directly operates 186 CNG-powered buses for fixed-route service. Table 7-1 presents a summary of Omnitrans' existing bus fleet.

Table 7-1. Summary of VVTA's Existing Bus Fleet

MANUFACTURER	SERIES	FUEL TYPE	LENGTH	IN SERVICE YEAR	BUS TYPE	NUMBER OF BUSES
New Flyer	C40LF*	CNG	40'	2003	Standard	12
	XN40	CNG	40'	2009	Standard	27
		CNG	40'	2011	Standard	17
		CNG	40'	2012	Standard	20
		CNG	40'	2014	Standard	16
		CNG	40'	2015	Standard	15
		CNG	40'	2016	Standard	13
		CNG	40'	2018	Standard	24
		CNG	40'	2019	Standard	23
	XN60	CNG	60'	2012	Standard	14
		CNG	60'	2018	Standard	1
					Total Buses	**186**

Note: *The C40LF serve as Omnitrans' contingency fleet.
Source: Omnitrans, July 2019

7.2.2 ZEB TECHNOLOGY APPLICATION

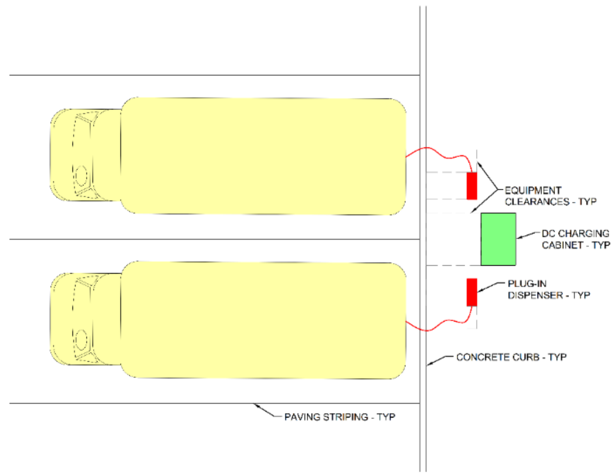
Past and ongoing ZEB analysis for Omnitrans' operations has determined that BEB adoption is the ZEB technology that best meets the needs of Omnitrans for their purchasing and transition requirements pursuant to the ICT regulation.

BATTERY-ELECTRIC BUS

Based on Omnitrans' existing service needs and site configurations, it is recommended that Omnitrans implements and adopts a combination of overhead and ground-mounted and island-mounted plug-in chargers to support the incoming BEBs at the West Valley and East Valley sites. The West Valley Division will have a combination of ground-mounted and island-mounted chargers, and the East Valley will have overhead-mounted chargers. The proposed full facility ZEB layout is based on utilizing a 150-kW DC charging cabinet used in a 1:2 charging ratio (one DC charging cabinet energizes two separate plug-in cord dispensers). This charger to dispenser ratio would meet the requirements to charge Omnitrans' fleet during the vehicles' servicing and dwell time on the site while minimizing the peak electrical demand for Omnitrans.

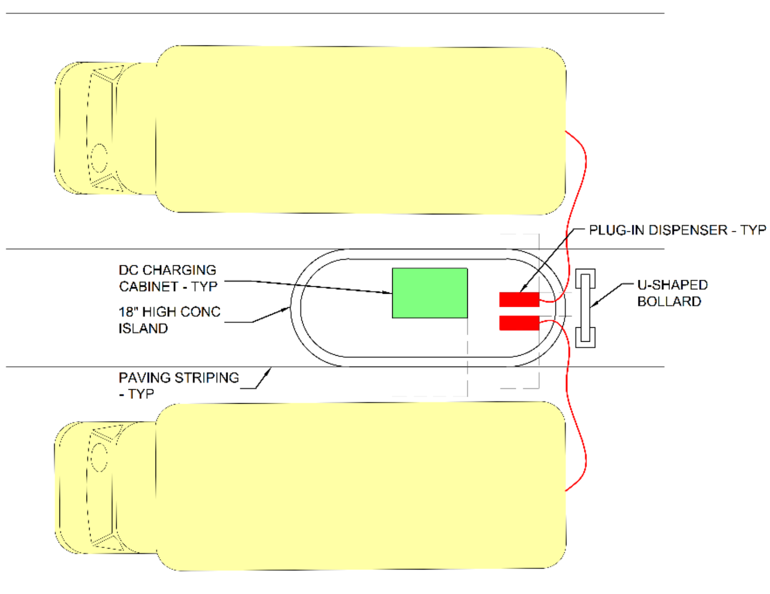
Omnitrans' future BEBs are expected to have specifications that are compatible with the Society of Automotive Engineers' (SAE) J1772 charging standard (e.g., "plug-in charging). It is recommended that Omnitrans specify charging ports on the front and rear of BEBs to allow for their existing site circulation and parking patterns to continue without additional modifications.

Figure 7-2. Ground-Mounted Plug-In Charger



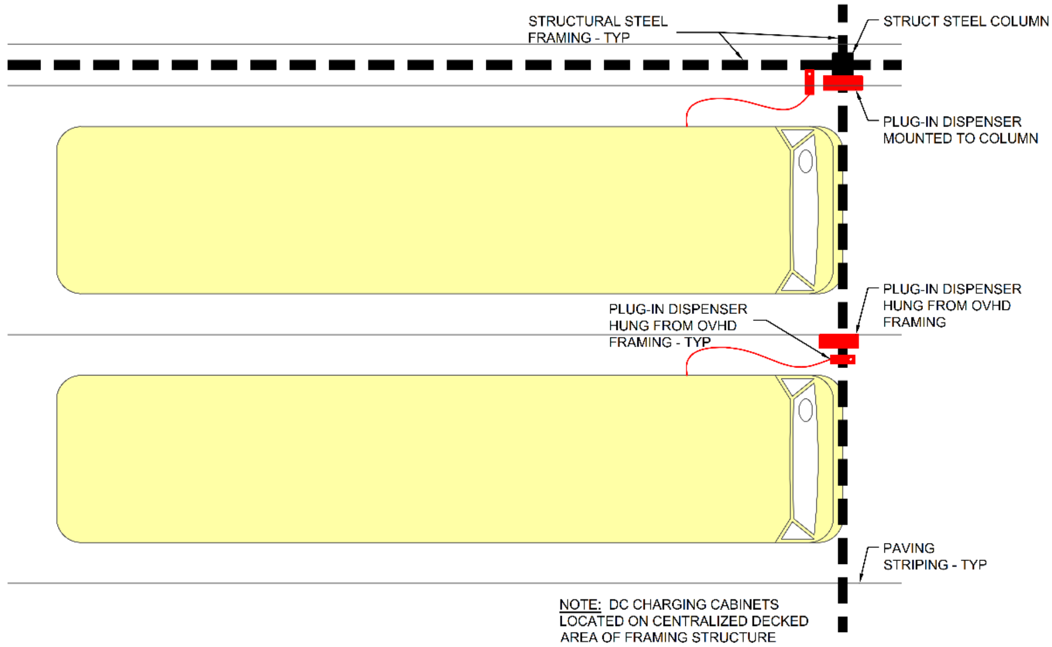
Source: WSP, July 2019

Figure 7-3. Island-Mounted Plug-In Charger



Source: WSP, July 2019

Figure 7-4. Overhead-Mounted Plug-In Charger with Retractable Cable



Source: WSP, July 2019

FUEL CELL ELECTRIC BUS

For the specific routes which the route modeling exercise has identified as not capable of being served by efficiently existing BEB technology, it is recommended that FCEBs be utilized and fueled either via future commercial or public hydrogen fueling stations located in either Ontario, Chino, or at a purpose-built Omnitrans containerized hydrogen storage and dispensing unit supplied via tank truck. Alternatively, an on-site modular electrolyzer, to generate hydrogen from water, could be used to eliminate the need to deliver hydrogen to the site. Note that while possible to self- generate, the available free areas at both Omnitrans' sites do not allow for a large enough electrolyzer to generate more hydrogen than could be used to fill four to six FCEBs, daily (assumption of 37 kilograms per bus at 350 bar).

7.2.3 EXISTING ZEB PROCUREMENTS AND PROJECTS

Omnitrans has a new solar canopy project currently in the design stages to add solar power generation via photovoltaic panels mounted on canopies over parking and on building roofs. Additionally, battery backup storage is proposed to be added to the sites.

7.2.4 PROCUREMENT SCHEDULE

In accordance with the ICT regulation, Omnitrans will prioritize ZEB purchases and progressively increase the percentage of ZEB purchases over time. Based on initial analysis, the last conventional bus is expected to be purchased in 2028. All new buses purchases are anticipated to be ZEB starting in 2029, in accordance with the ICT regulation.

Early retirement should not be an issue pursuant to the ICT regulation based on Omnitrans' assumed procurement schedule. However, if it becomes one, Omnitrans will deploy a number of strategies to ensure that buses fulfill their "useful life". One potential strategy is to place newly acquired buses on Omnitrans' longest (distance) blocks of service. This will ensure that these buses meet their distance-based useful life requirement more rapidly.

Omnitrans existing fleet consists of 186 buses. Assuming a 1:1 replacement ratio, each existing bus will eventually be replaced with an equivalent BEB or FCEB buses. However, the number of ZEBs required may increase with time based on service requirements.

Table 7-2 presents a summary of Omnitrans' anticipated bus procurements through 2040. Years 2023, 2026 and 2029 are highlighted because these indicate when Omnitrans' new purchases should be 25 percent, 50 percent, and 100 percent ZEBs, respectively.

Table 7-2. Summary of Omnitrans' Future Bus Purchases (through 2040)

YEAR	TOTAL BUSES	ZERO-EMISSION BUSES				CONVENTIONAL (CNG) BUSES			
		NUMBER	PCT.	BUS TYPE	FUEL TYPE	NUMBER	PCT.	BUS TYPE	FUEL TYPE
2020	**0**	0	0%	-	-	0	0%	-	-
2021	**0**	0	0%	-	-	0	0%	-	-
2022	**0**	0	0%	-	-	0	0%	-	-
2023	**0**	0	0%	-	-	0	0%	-	-
2024	**18**	5	28%	40'	BEB	13	72%	40'	CNG
2025	**17**	4	24%	40'	BEB	13	76%	40'	CNG
2026	**34**	17	50%	40'/60'	BEB	17	50%	40'/60'	CNG
2027	**0**	0	0%	-	-	0	0%	-	-
2028	**16**	8	50%	40'	BEB	8	50%	40'	CNG
2029	**15**	15	100%	40'	BEB	0	0%	-	-
2030	**13**	13	100%	40'	BEB	0	0%	-	-
2031	**0**	0	0%	-	BEB	0	0%	-	-
2032	**25**	25	100%	40'/60'	BEB	0	0%	-	-
2033	**23**	23	100%	40'	BEB	0	0%	-	-
2034	**0**	0	0%	-	BEB	0	0%	-	-
2035	**0**	0	0%	-	BEB	0	0%	-	-
2036	**7**	7	100%	40'	BEB	0	0%	-	-
2037	**4**	4	100%	40'	BEB	0	0%	-	-
2038	**37**	37	100%	40'/60'	BEB	0	0%	-	-
2039	**13**	13	100%	40'	BEB	0	0%	-	-
2040	**33**	33	100%	40'/60'	BEB	0	0%	-	-

Source: WSP, February 2020

7.2.5 ZEB RANGE REQUIREMENTS AND COSTS

Omnitrans operates 334 blocks during weekdays, 296 of which are longer than 100 miles. Omnitrans' longest block is approximately 410 miles. Depending on operational parameters, including operator behavior, ambient temperature, traffic, and ridership, these ranges may be unattainable or difficult to achieve on certain days. To reduce impacts to service, Omnitrans will consider a number of strategies to supplement onboard battery storage, including additional buses, midday charging, battery/charging management systems, and solar and battery storage. In future ZEB applications, Omnitrans may also consider FCEBs, especially if battery technology doesn't advance as forecasted. Table 5-3 presents the required range and estimated cost of ZEBs through 2040

Table 7-3. Range and Estimated Costs of Future ZEB Purchases

YEAR	TOTAL ZEBS	BUS TYPES	REQUIRED RANGE (MI.)	ESTIMATED COST/BUS
2024	18	BEB	175	$1,000,000
2025	17	BEB	175	$1,000,000
2026	34	BEB	175	$1,000,000
2028	16			
2029	15			
2030	13			
2032	25			
2033	23			
2036	7			
2037	4			
2038	37			
2039	13			
2040	33			

Source : WSP, February 2020

7.2.6 ZEB CONVERSIONS

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

7.3 FACILITIES AND INFRASTRUCTURE MODIFICATIONS

The following sections detail the planned charging strategies, infrastructure, detailed base improvements, and program schedule.

7.3.1 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. For that reason, the recommended facility and infrastructure modifications are based on what can physically be accommodated at each facility. This is based on the number of existing vehicles plus a predetermined growth factor (or space at the division). This provides the agency with a ceiling for what can physically be constructed and at what cost. Service changes and bus movements may happen multiple times a year, for some agencies. By establishing a full build scenario, agencies can optimize, and tailor strategies based on existing (or anticipated) service for implementation.

The analysis of FCEBs at each agency is ongoing, however, a hydrogen storage footprint was established at each division where vehicles and space can support it. Further analysis (Master Plan and subsequent studies) will analyze alternatives of hydrogen delivery.

In the case of Omnitrans, the full build scenario is presented for context. However, refinements and tailored strategies will be developed in the Master Plan and future implementation studies.

7.3.2 FACILITY MODIFICATIONS

Omnitrans' transition to ZE technologies, will require a number of modifications and changes to existing infrastructure and operations. This would include the enhancements and expansions of electrical equipment, additional electrical capacity, and the installation of BEB chargers, dispensers, and other components. These modifications will occur at Omnitrans' two divisions, the West Valley Division in City of Montclair, and the East Valley Division in the City of San Bernardino.

Based on Omnitrans' existing service needs and site configurations, Omnitrans plans on installing ground- and island-mounted plug-in chargers at West Valley and overhead plug-in chargers at East Valley. The proposed full facility layout is based on utilizing a 150-kW DC charging cabinet used in a 1:2 charging ratio (one DC charging cabinet energizes two separate plug-in cord dispensers). This charger to dispenser ratio would meet the requirements to charge Omnitrans' fleet during the vehicles' servicing and dwell time on the site while minimizing the peak electrical demand.

Figure 7-5 illustrates the location of Omnitrans' divisions and Table 7-4 summarizes the modifications and schedule of each base and the following sections detail the process of each division's transition from existing conditions to BEB-readiness.

Figure 7-5. Omnitrans' Base Locations

Table 7-4. Omnitrans' Division Summary

GARAGE	ADDRESS	MAIN FUNCTIONS	PLANNED INFRASTRUCTURE	EXISTING/REQ'D CAPACITY (MW)	UPGRADES REQ'D?	TIMELINE
West Valley	4748 E. Arrow Hwy. Montclair, CA	Fueling, Storage, and Maintenance	Plug-In Charging to support 63 buses by 2025	5 MW	Yes	2021-2026

East Valley	1700 W. 5th St. San Bernardino, CA	Fueling, Storage, and Maintenance	Plug-In Charging to support 120 buses by 2025	5 MW	Yes	2021-2026

Source: WSP, February 2020

WEST VALLEY DIVISION

EXISTING CONDITIONS

West Valley Division is located at 4748 E. Arrow Highway in the City of Montclair. The division has an existing electrical capacity of XX MW with electrical service provided by (SCE).

Currently, 189 CNG-powered buses are stored, maintained, fueled, and serviced at the division. The West Valley facility includes the following separate structures and major site areas: a one-story maintenance building, one-story transportation building, stand-alone wash building, stand-alone fuel building, an employee parking lot, and a CNG compressor yard with support equipment. Employee parking is on site in the employee parking lot Arrow Highway.

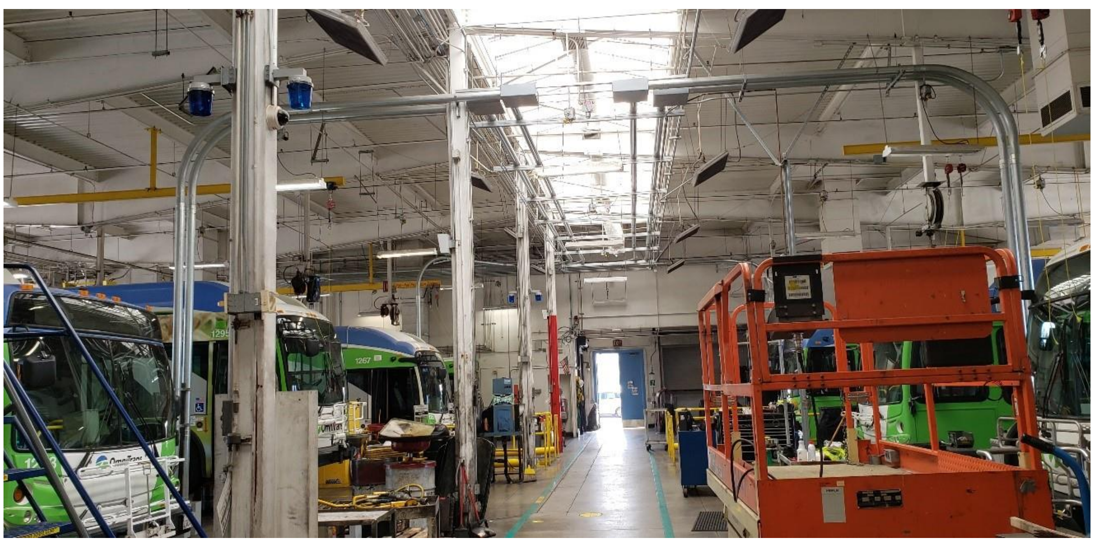
Buses enter from Arrow Highway and park in the yard before undergoing service. Individual buses are then taken by Omnitrans nightly service staff to the fuel lanes for fare retrieval and fueling before pulling forward to the bus wash lanes. After fuel and wash, buses are circulated back into the bus parking tracks, parking in either herringbone or angled configurations. The interiors of the buses are cleaned during the fueling process. Once re-parked after nightly service, buses remain parked in-place until morning pull out unless a maintenance issue has been identified.

All bus parking tracks are approximately 13-foot wide and buses are not assigned to specific spaces. Non-revenue vehicles (NRVs) are parked in a row of spaces along the western edge of the bus parking spaces. Additionally, battery electric NRV’s are parked and charge along the eastern wall of the maintenance facility.

Figure 7-6. West Valley Division - Existing Conditions

Source: Google Earth, February 2020

Figure 7-7. West Valley Division's Maintenance Bays



Source: WSP, February 2020

PLANNED ZEB MODIFICATIONS

Based on the recommended ground-mounted DC plug-in charging solution, the West Valley division is capable of parking 63 buses with 63 plug-in charging positions in a 1:2 charger to bus dispenser ratio.

Table 7-5 summarizes the ZEB infrastructure planned at the West Valley division.

Table 7-5. West Valley Division Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY
Omnitrans	West Valley	Ground-Mounted; Plug-In	32	63	150 kW	Storage/ Delivery

Source : WSP, February 2020

The following BEB equipment and locations are proposed:

— 10 island-mounted charging cabinets along the west edge of the existing northern herringbone track parking with 20 plug-in dispenser charging positions each located adjacent to an existing parking space near the front of each bus.

— Four island-mounted charging cabinets along the east edge of the existing northern herringbone track parking with seven plug-in dispenser charging positions each located adjacent to an existing parking space near the front of each bus.

— Six island-mounted charging cabinets along the west edge of the existing southern herringbone track parking with 12 plug-in dispenser charging positions each located adjacent to an existing parking space near the front of each bus.

— Five island-mounted charging cabinets along the east edge of the existing southern herringbone track parking with 10 plug-in dispenser charging positions each located adjacent to an existing parking space near the front of each bus.

— Seven ground-mounted charging cabinets evenly distributed with 14 plug-in dispenser charging positions along the eastern yard pavement edge with 14 plug-in dispenser charging positions at the front of the existing pull-in parking spaces.

The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

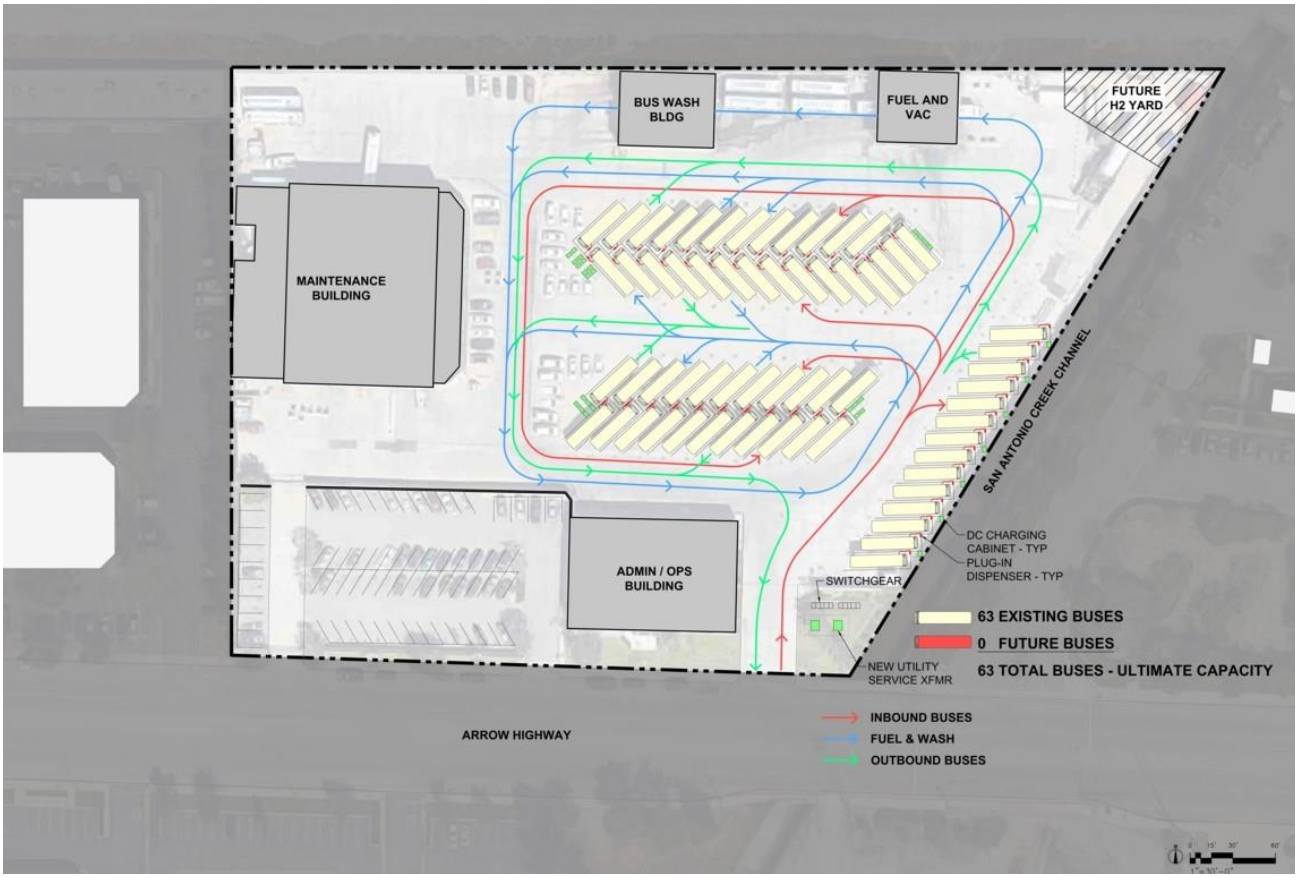
— Two medium voltage utility service transformers in a new utility yard in the open space south of the existing parking yard and east of the site entrance.

— Two sets of switchgear in a new utility yard in the open space south of the existing parking yard and east of the site entrance.

Hydrogen fueling for the routes unable to be completed with BEBs is recommended to be located in a new hydrogen fueling yard located on the northeast corner portion of the site adjacent to the existing CNG yard if commercially available hydrogen fueling stations are not utilized. WSP recommends utilizing a containerized hydrogen solution with hydrogen delivered for on-site compression to meet Omnitrans' initial hydrogen fueling needs and transitioning to larger hydrogen storage and compression via replacing the outgoing CNG systems if the fleet mix trends towards greater hydrogen utilization.

Figure 7-8 illustrates the West Valley Division at full build-out.

Figure 7-8. West Valley Division – Full ZEB Build-Out



Source: WSP, February 2020

EAST VALLEY DIVISION

EXISTING CONDITIONS

East Valley Division is located at 1700 West 5th Street in the City of San Bernardino. The base has an existing electrical capacity of XX MW with electrical service provided by (SCE).

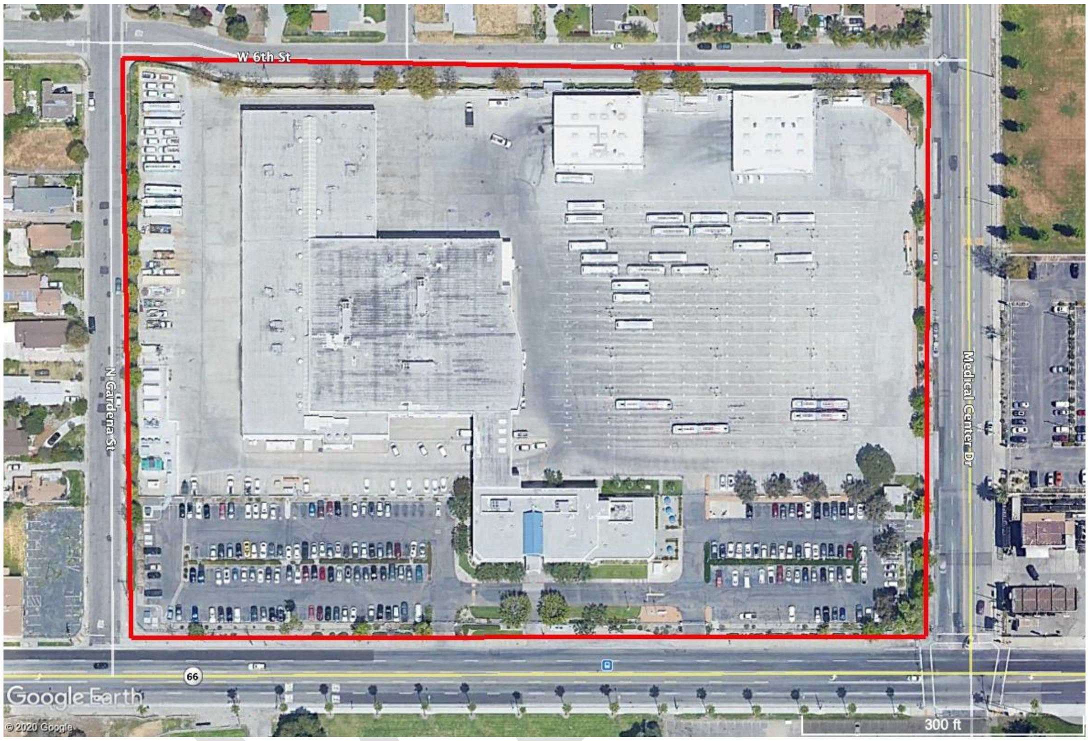
Currently, 120 CNG-powered buses are stored, fueled, and serviced at the division. The East Valley facility includes the following separate structures and major site areas: a one-story maintenance building, one-story transportation building, stand-alone wash building, stand-alone fuel building, an employee parking lot, and a CNG compressor yard with support equipment. Employee parking is on site in the employee parking lot along 5th Street or the satellite employee parking, which is off of Medical Center Drive.

Buses enter from Medical Center Drive and park facing west in the yard before undergoing service. Individual buses are then taken by Omnitrans nightly service staff to the fuel lanes for fare retrieval and fueling before pulling forward to the bus wash lanes. After fuel and wash, buses are circulated back into the bus parking tracks and re-parked facing east in nose-to-tail tracks. The interiors of the buses are cleaned during the fueling process. Once re-parked after nightly service, buses remain parked in-place until morning pull out unless a maintenance issue has been identified.

All bus parking tracks are approximately 13-foot wide and buses are not assigned to specific spaces. NRV vehicles are parked in a row of spaces along the southern edge of the maintenance building and the southern fence in the bus circulation area south from the maintenance building. Additionally, battery electric NRV's are parked and charge along the southern fence in this area.

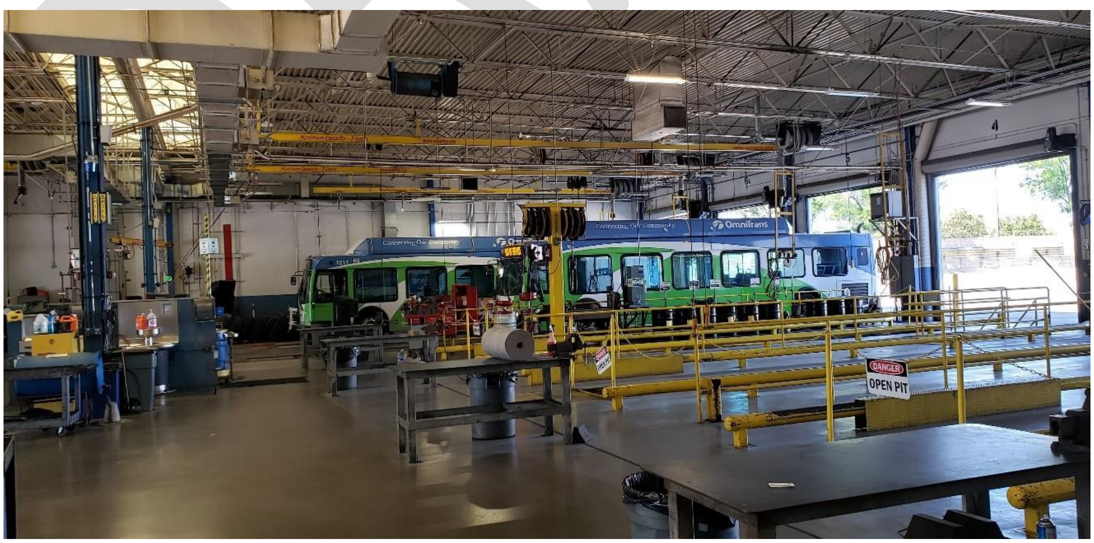
The current site may have space available for ground-level electric bus charging equipment, although with tight tolerances for equipment clearances. The site is already equipped with lighter-than-air upgrades, so hydrogen compatibility will require only hydrogen-specific upgrades such as gas detection and any outside space necessary to host storage or production equipment.

Figure 7-9. East Valley Division - Existing Conditions



Source: Google Earth, February 2020

Figure 7-10. East Valley Division's Maintenance Bays



Source: WSP, February 2020

PLANNED ZEB MODIFICATIONS

Based on the recommended overhead platform-mounted retractor cord DC plug-in charging solution, the Big Bear Lake base is capable of parking 120 buses with 120 plug-in charging positions in a 1:2 charger to bus dispenser ratio. Ground-mounted charging cabinets and dispensers are not recommended for East Valley as they would create a significant reduction in bus parking capacity due to parking losses to accommodate ground-mounted charging equipment.

Table 7-6 summarizes the ZEB infrastructure planned at the East Valley division.

Table 7-6. East Valley Division Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY*
Omnitrans	East Valley	Overhead; Plug-In	60	120	150 kW	Storage/ Delivery

Source : WSP, February 2020

The following BEB equipment and locations are proposed:

— 60 charging cabinets located on a centralized overhead platform above the parking racks. Distribution to 120 retractor cord plug-in dispenser charging positions mounted from an overhead support structure in the existing track parking.

— Dispensers are located for connecting to the front of the bus to reduce the length of support structure at the rear of the parking tracks in order to maintain bus turning clearances. Additionally, the eastern-most front row of tracks will have the dispensers staggered back slightly to allow for less support structure and easier maneuvers out of the track parking area.

— Maintaining the existing parking and island structure will allow for overhead support structure columns to be placed every three tracks. These columns will also provide the mounting space for retractor cord controls to be installed to control each overhead dispenser's charging cable position.

The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

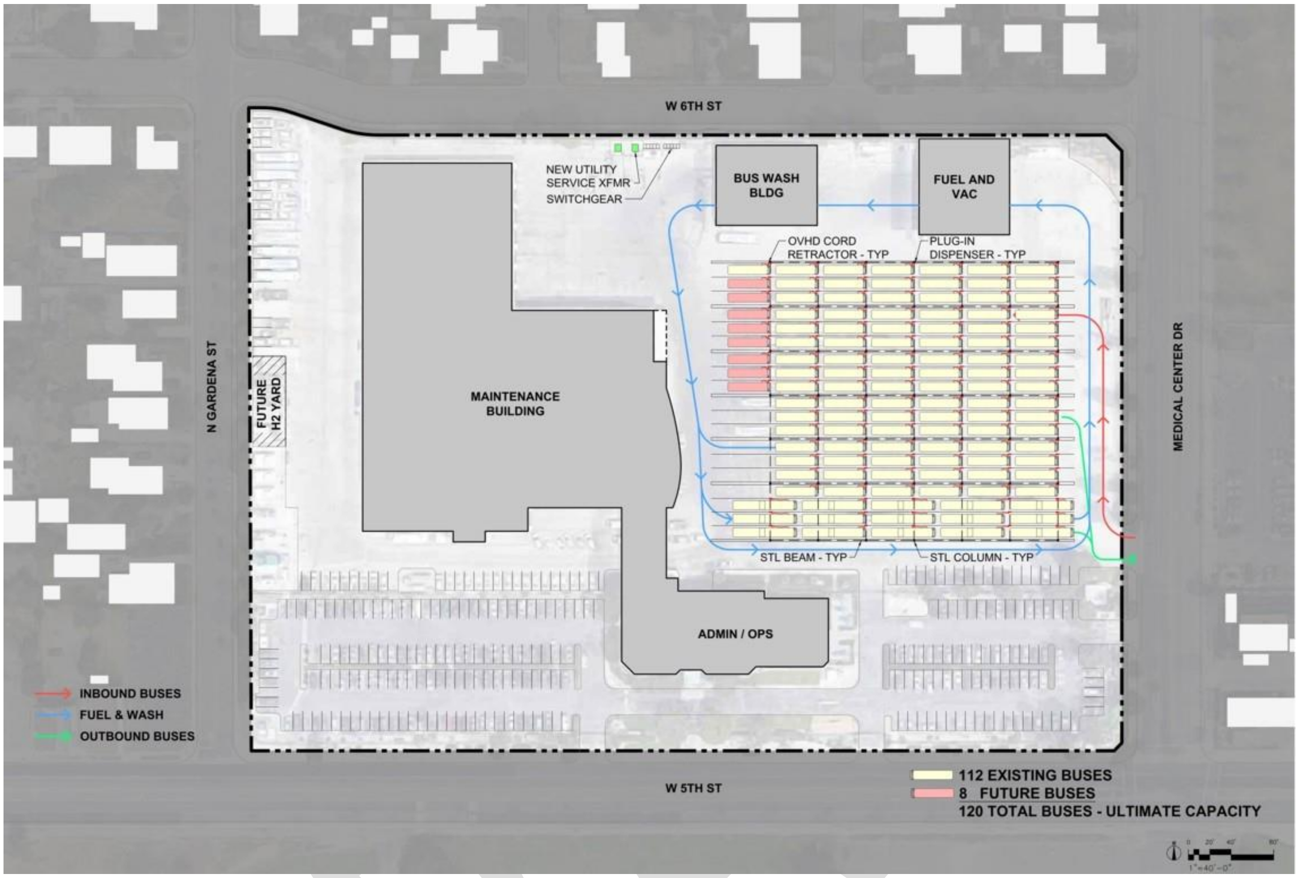
— Two medium voltage utility service transformers in a new utility yard in the open space along the northern site wall and west of the existing bus wash.

— Two sets of switchgear in a new utility yard in the open space along the northern site wall and west of the existing bus wash.

Hydrogen fueling for the routes unable to be completed with BEBs is recommended to be located in a new hydrogen fueling yard located on the central western edge of the site adjacent to the existing CNG yard if commercially available hydrogen fueling stations are not utilized. WSP recommends utilizing a containerized hydrogen solution with hydrogen delivered pre-compressed to meet Omnitrans' initial hydrogen fueling needs and transitioning to larger hydrogen storage and compression via replacing the outgoing CNG systems if the fleet mix trends towards greater hydrogen utilization.

Figure 7-11 illustrates the East Valley Division at full build-out.

Figure 7-11. East Valley Division – Full ZEB Build-Out



Source: WSP, February 2020

7.3.3 PHASING AND CONSTRUCTION SCHEDULE

Adhering to the construction schedule and milestones will be critical because the facilities' construction must be completed before buses are delivered, otherwise, the buses will not be able to operate. To accomplish this, construction for BEB-supporting infrastructure is expected to be done in phases to minimize disruption of operations. West Valley Division is expected to be completed in three phases, and East Valley Division is expected to be completed in two.

Additional electrical capacity will be required to meet the service needs of buses at both divisions. Construction and enhancements to bring this additional electrical capacity is anticipated to take three to five years based on electrical utilities' protocol. This timeframe would include method of service studies, design, and construction. It is recommended that electrical infrastructure such as transformers and switchgears be installed with the initial phase at both West Valley and East Valley divisions to avoid the disruption of ongoing charging operations or install duplicate infrastructure in subsequent phases.

The following provides details on recommended phasing for each division.

WEST VALLEY DIVISION

PHASE 1

The recommended first phase of charger installation the for the West Valley Division is to install all of the in-ground conduit to route electrical service from the new electrical yard to seven charging cabinets with 14 plug-in dispensers mounted at the edge of the parking spaces on the eastern boundary of the yard. These chargers and dispensers can be installed without any trenching modification to the existing parking areas.

PHASE 2

Phase 2 at West Valley should perform yard trenching to distribute electrical service to the southern yard parking area and construct both the east and west edge islands to house the charging cabinets and the in-space dispensers for an additional 22 charging positions.

PHASE 3

Phase 3 at West Valley should complete yard trenching to distribute to electrical service to the northern yard parking grouping and construct both the east and west edge islands to house the charging cabinets and the in-space dispensers.

Hydrogen fueled vehicles are recommended for initial implementation during Phase 2 as a large portion of the CNG demand will have been reduced on the site. This will allow a partial phase-out of the CNG yard and equipment so that a containerized hydrogen solution can be installed in the partially decommissioned CNG area. Upon completion of Phase 3 and full CNG decommissioning on the site, the future hydrogen storage can be increased to meet any growth in demand and on-site compression can also be implemented if necessary or financially beneficial.

EAST VALLEY DIVISION

PHASE 1

The recommended first phase of charger installation the for the East Valley site is to install all of the in-ground conduit to route electrical service from the new electrical service yard to the proposed overhead structure and charging cabinet platform. A portion of the support structure should be installed over the northern half of the exiting parking tracks and the charging cabinet platform should be installed on the southern central edge of the new support structure to support the initial 30 charging cabinets. The conduit routing power from the electrical yard to the support structure should be sized for the ultimate distribution demand to meet the needs of the subsequent phase without further trenching. 60 overhead retractor cable plug-in charging dispensers will be hung from the new support structure to serve each of the covered parking spaces and controls for the retractor cable in each spot will be located on the nearest support structure column.

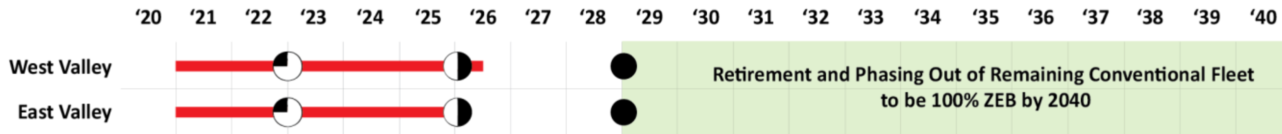
PHASE 2

Phase 2 at East Valley will consist of creating the southern half of the support structure and charging cabinet in a mirrored design of the northern portion completed in Phase 1. The additional transformer and switchgear will be installed on the pads and conduit constructed in the electrical yard during Phase 1 and routed via the overhead support structure, so no new trenching will be required. The new support structure housing an additional 60 retractor cable plug-in charging dispensers and overhead platform with 30 additional charging cabinets will be installed to provide the entire yard with charging capabilities

Hydrogen fueled vehicles are recommended for initial implementation at the completion of Phase 1 as 50 percent of the CNG demand will have been reduced on the site. This will allow a partial phase-out of the CNG yard and equipment so that a containerized hydrogen solution can be installed in the partially decommissioned CNG area. Upon completion of Phase 2 and full CNG decommissioning on the site, the future hydrogen storage can be increased to meet any growth in demand and on-site compression can also be implemented if necessary or financially beneficial.

Figure 7-12 presents the proposed construction schedule for Omnitrans' transition to ZEBs. The Harvey Balls indicate the percentage of new buses that need to be ZEB pursuant to the ICT regulation.

Figure 7-12. Omnitrans Construction Schedule



Source: WSP, February 2020

7.4 DISADVANTAGED COMMUNITIES

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, as 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.

7.4.1 OMNITRANS' DISADVANTAGED COMMUNITY ANALYSIS

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

At this time, both the West Valley and the East Valley divisions are located in areas considered "disadvantaged". Both yards also serve routes that traverse DACs. The West Valley division serves 129 communities, 78 of which (60 percent), are considered disadvantaged. Whereas, the East Valley division serves 163 communities, 103 of which (63 percent), are considered disadvantaged.

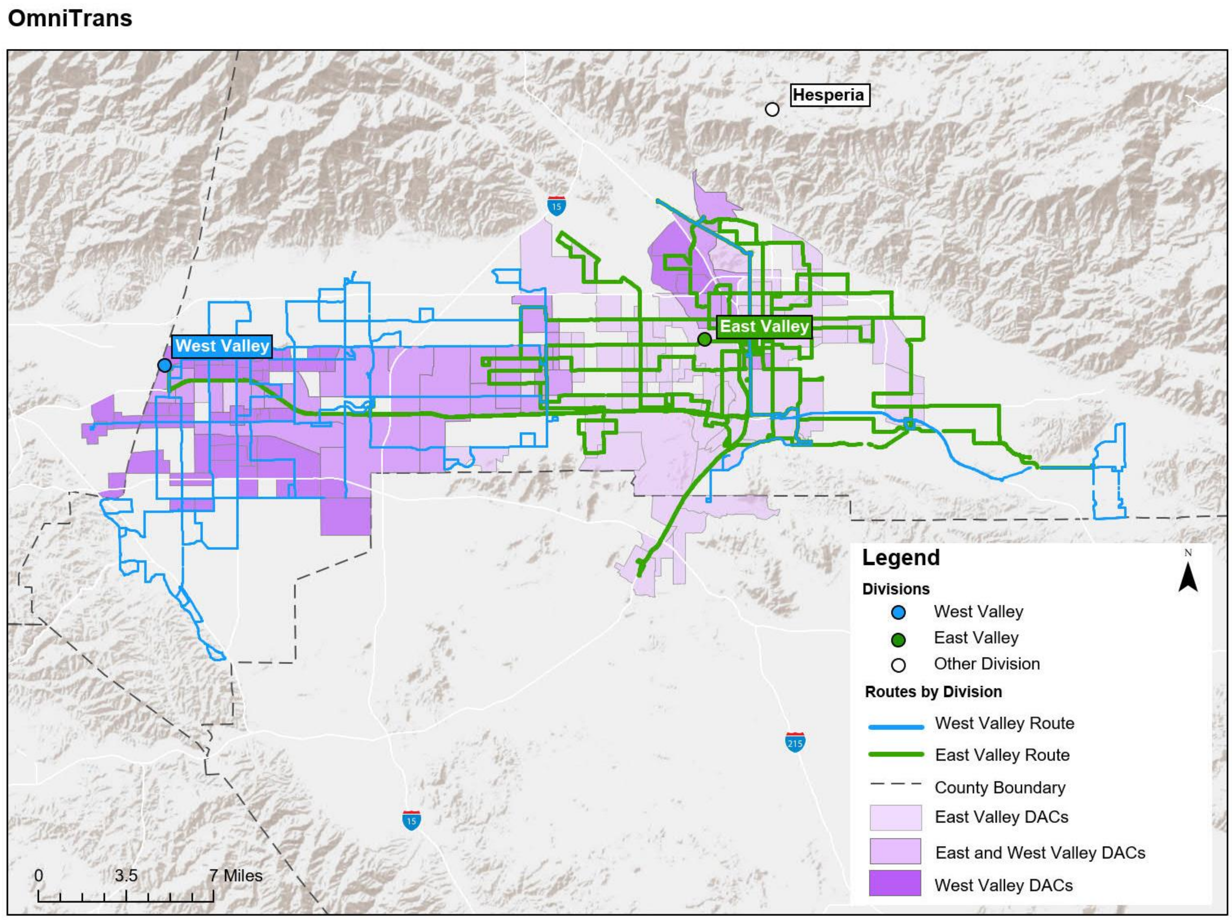
Table 7-7 summarizes Omnitrans' divisions and census tracts served in terms of DACs. Figure 7-13 illustrates Omnitrans' divisions and the census tracts that they serve.

Table 7-7. Omnitrans' Disadvantaged Communities

DIVISION	IN DAC?	NOX EXEMPT AREA?	COMMUNITIES SERVED	DAC'S SERVED	PCT. OF DACS SERVED
West Valley	Yes	Yes	129	78	60%
East Valley	Yes	Yes	163	103	63%

Source : CalEnviroScreen 3.0, February 2020

Figure 7-13. Omnitrans' Disadvantaged Communities



Source : CalEnviroScreen 3.0, February 2020

7.5 WORKFORCE TRAINING

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

7.5.1 TRAINING REQUIREMENTS

The transition to ZEBs will significantly alter Omnitrans' service and operations. Converting to ZEBs from diesel is an arduous endeavor and will impact all ranks of the organization. This will require extensive change management and training, some of which will be provided by the OEMs, others by Omnitrans and outside organizations. Training will need to be conducted well in advance of the delivery of the first buses and will be ongoing throughout the lifecycle of the technology.

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
  Bus operators will need to be familiarized with the buses, safety, bus operations, and pantograph operations.

— Facilities Maintenance Staff and Maintenance
City 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.

— Body Repairers
Body repairers at the contracted operator will need to be familiarized with the safety-related features and other components of ZEBs.

— Instructors
Maintenance instructors will need to understand all aspects of the transition of ZEBs to train others.

— Service Attendants
Staff will become familiarized with proper charging protocol and procedures that are ZEB-specific.

— Management Staff
All Management will be familiarized with ZEB operations and safety procedures.

Table 7-8: Omnitrans' ZEB Training Summary

TRAINING PROGRAM/CLASS	PURPOSE OF TRAINING	NAME OF PROVIDER	NUMBER OF TRAINEES	TRAINEES' POSITIONS	TRAINING HOURS	TRAINING FREQUENCY	ESTIMATED COSTS PER CLASS

Source : WSP, February 2020

7.6 COSTS AND FUNDING

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

7.6.1 PRELIMINARY COSTS

As expected, the cost of ZEB adoption is going to be very expensive. While actual costs (capital and operations & maintenance) of the transition are still being determined and evaluated, it is assumed that a full transition for just the buses and chargers (based on existing conditions) will cost approximately $113.8 million (in 2020 dollars). This assumes of approximately $100K and $50k for charging equipment (DC cabinets and dispensers) and support equipment (conduit, trenching, cabling, etc.), respectively, per bus. This also includes an assumed cost of $500K per bus, however, this will vary depending on length, customizations, etc.

7.6.2 POTENTIAL FUNDING SOURCES

There are a number of potential Federal, State, local, and project-specific funding and financing sources at Omnitrans' disposal. Omnitrans will monitor funding cycles and pursue opportunities that yield the most benefits for the agency pursuant to the ICT regulation. The following table identifies the many funding opportunities that Omnitrans may take advantage of in the next 20 years.

Table 7-9. ZEB 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
	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

TYPE	AGENCY	FUNDING MECHANISM
		Parking Fees
		Tax Rebates and Reimbursements
		Enhanced Infrastructure Financing Districts
		Opportunity Zones

Source : WSP, February 2020

7.7 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 Omnitrans has identified. The following sections briefly describe some of the challenges that Omnitrans faces for its transition.

- **Range issues.** Omnitrans has some blocks that exceed current BEB range. This means that Omnitrans will have to consider the following strategies to reduce or avoid service disruptions:
  - **Buy more buses.** This can assist with service requirements; however, more buses will require more chargers, more space at the division, and potentially higher utility costs.
  - **Opportunity charging.** This strategy could potentially reduce the costs (per bus) due to a smaller battery requirement, however, it would result in more capital infrastructure and utility costs.
  - **Service changes.** This would require the manipulation of block structure. While the riders may not notice the change, the agency will have to consider the potential impacts to operator and maintenance costs.
- **Technological adaptation (FCEB, BEB, or both?).** Currently, Omnitrans is modeling and planning for a transition based on existing service and ZEB technology. With the 2040 deadline looming, it is difficult to anticipate future technological enhancements and changes, such as improved batteries and chargers. Slight changes in these technologies could improve bus ranges, in turn, reducing costs. Omnitrans (and the market) has to be aware of these changes as it would be counterproductive to invest in technologies that will soon be outdated.
- **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. Omnitrans 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.
- **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, however, it will also make it challenging to meet ZEB goals for agencies if supply of buses can meet with demand.

8 VICTOR VALLEY TRANSIT AUTHORITY

8.1 INTRODUCTION

Victor Valley Transit Authority (VVTA) is a joint-powers authority established between San Bernardino County, the Town of Apple Valley, and the cities of Adelanto, Barstow, Hesperia, and Victorville.

8.1.1 SERVICE AREA

VVTA serves the four major cities and their surrounding areas in the high desert area. VVTA also operates transit service to and within the City of Barstow, a relatively isolated city of approximately 22,000, 30 miles northeast of Victorville and halfway between Los Angeles and Las Vegas.

VVTA's service area is large. While its legacy Victor Valley routes all serve cities that share borders, those cities are not densely developed, and the developed portions of the cities are separated, in some cases, by more than 20 miles. Barstow is relatively compact in its development, but it is isolated and smaller than the Victor Valley cities. Additionally, the VVTA operates a limited service route to the City of Needles approximately 175 miles east of Victorville.

Figure 8-1. VVTA Service Area

Source: WSP

8.1.2 ENVIRONMENTAL FACTORS

VVTA predominantly operates its services in the Mojave Desert, where summer high temperatures often reach 100 degrees while winter low temperatures often drop below freezing. The area experiences very little rainfall and snowfall. The service area itself is largely flat, but it sits in the high desert with elevations of approximately 3,000 feet in Victor Valley and 2,200 feet in Barstow. Elevation changes frequently across the mountainous desert terrain. These elevation changes will reduce the potential range of ZEBs serving these routes.

8.1.3 SCHEDULE AND OPERATIONS

VVTA operates 30 regular routes, eight commuter routes, and one special route across its service area.

VVTA's regular routes are:

— Adelanto: routes 31, 32, and 33
— Apple Valley: routes 23, 40, 41, 42, 43, and 47
— Barstow: routes 1, 2, 3, 6, 28, and 29
— Hesperia / Oak Hills: routes 24A, 24B, 66, and 68
— Victorville: routes 15, 21P, 21W, 22, 50, 50X, 51, 52, 53, 54, and 55

All eight commuter routes serve Fort Irwin National Training Center (NTC), a major training area for the United States military in the Mojave Desert approximately 36 miles northeast of Barstow. Not all commuter routes are round trips - trips inbound to NTC in the AM are designated "A" and return trips in the PM are designated "B." The routes originate from the following locations:

— Victorville: routes 101A and 101B (Bear Valley Road)
— Hesperia: routes 102, 103, 105 (L Street) and 107
— Helendale: route 105
— Barstow: route 106 (Williams park-and-ride)

Lastly, VVTA offers the intercity Route 200, the "Needles Link." Route 200 operates Friday-only service, a roundtrip of more than 350 miles, the route stops only at Needles G Street, the Barstow Library, the Victorville Transfer Point, and the Victorville Court House. VVTA began offering this service in 2016 to provide alternate transportation to the courts in Barstow and Victorville in the wake of state funding cuts to courts in Needles and Barstow. Needles residents can reserve a seat on Route 200 with curb-to-curb pick-up in advance.

VVTA's longest route is Route 200 to Needles at 513 miles for a roundtrip. Even leaving aside this outlier, its other routes generally range from 92 to 352 miles roundtrip for the Barstow routes and 84 to 393 miles roundtrip in the Hesperia/Victor Valley Routes.

8.2 FLEET AND ACQUISITIONS

The following section provides an overview of VVTA's existing fleet, planned purchases, and description of how VVTA will meet the requirements of the ICT regulation.

8.2.1 EXISTING BUS FLEET

As of July 2019, VVTA directly operates 61 CNG-powered buses for fixed-route service. Table 8-1 presents a summary of MT's existing bus fleet.

Table 8-1. Summary of VVTA's Existing Bus Fleet

MANUFACTURER	SERIES	FUEL TYPE	LENGTH	IN SERVICE YEAR	BUS TYPE	NUMBER OF BUSES
Glaval	Entourage	CNG		2012	Standard	2
El Dorado	Aero Elite 320	CNG		2012	Standard	2
	Aerolite 320	CNG		2013	Standard	4
	XHF 35'	CNG	35'	2016	Standard	2
	Axess-40	CNG	40'	2014	Standard	9
	Axess-40	CNG	40'	2015	Standard	1
	Axess-35'	CNG	35'	2018	Standard	5
	Axess – 40'	CNG	40'	2018	Standard	11
NABI	40LFW-40	CNG	40'	2008	Standard	7
		CNG	40'	2011	Standard	5
	40LWF 14	CNG	40'	2013	Standard	4
		CNG	40'	2014	Standard	4
MCI	D4500	CNG		2015	Standard	4
					Total Buses	**61***

Source: Victor Valley Transit Authority, July 2019
Note: VVTA also owns seven BEB-powered buses. It is unclear if these are currently in operation.

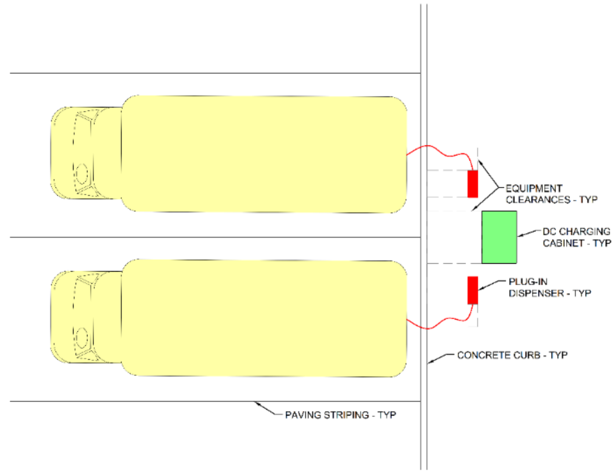
8.2.2 ZEB TECHNOLOGY APPLICATION

Past and ongoing ZEB analysis for VVTA's operations has determined that BEB adoption is the ZEB technology that best meets the needs of VVTA for their purchasing and transition requirements pursuant to the ICT regulation. FCEBs are an option for blocks that are unable to be completed with BEBs.

BATTERY-ELECTRIC BUS (BEB)

VVTA's future BEBs are expected to have specifications that are compatible with the Society of Automotive Engineers' (SAE) J1772 charging standard (e.g., "plug-in charging") (Figure 8-2). It is recommended that VVTA specify charging ports on the rear of BEBs to allow for their existing site circulation and parking patterns to continue without additional modifications. Battery sizing (kilowatts) will be determined based on service needs requirements and what is available and feasible based on costs and weight. Charger rating (kilowatt-hour) will be based on service needs, battery acceptance, and costs.

Figure 8-2. Ground-Mounted Plug-In Charger



Source: WSP, February 2020

FUEL CELL ELECTRIC BUS (FCEB)

For the specific routes which the route modeling exercise has identified as not capable of being served by efficiently existing BEB technology, it is recommended that FCEBs be utilized and fueled either via future commercial/public hydrogen fueling stations or a purpose built VVTA containerized hydrogen storage and dispensing unit with hydrogen delivery to the site via liquid hydrogen tank truck and stored on site.

8.2.3 EXISTING ZEB PROCUREMENTS AND PROJECTS

In November 2019, VVTA replaced seven of its CNG vehicles with seven BEBs (five 35-footers and two 40-footers). These buses are equipped with 466 kWh of battery capacity and are fueled by electrical power via ChargePoint CP-250 chargers (62.5 kW) at the Hesperia Yard.

There is also a new facility under construction in Barstow (expected completion in 2020) which will expand and enhance the existing Barstow site. The current Barstow Yard is a small operation and joint venture with the City of Barstow and Transdev. The Barstow Yard (Future) is designed to accept ChargePoint Power Blocks DC charging cabinets of 156+ kW. Although not commercially available at the time of this report, this technology is anticipated to be available in the near future. The charging equipment and electrical infrastructure will be installed in space between the existing CNG fueling site and the new bus parking yard.

It should also be noted that VVTA's newly acquired ZEBs will qualify for ZEB Bonus Credits as defined in the ICT regulation.

8.2.4 PROCUREMENT SCHEDULE

In accordance with the ICT regulation, VVTA will prioritize ZEB purchases and progressively increase the percentage of ZEB purchases over time. Based on initial analysis, the last conventional bus is expected to be purchased in 2022. All new buses purchases are anticipated to be ZEB starting in 2029.

Early retirement should not be an issue pursuant to the ICT regulation based on VVTA's assumed procurement schedule. However, if it becomes one, VVTA will deploy a number of strategies to ensure that buses fulfill their "useful life". One potential strategy is to place newly acquired buses on VVTA's longest (distance) blocks of service. This will ensure that these buses meet their distance-based useful life requirement more rapidly.

VVTA's existing fleet consists of 61 buses. Assuming a 1:1 replacement ratio, each existing bus will eventually be replaced with an equivalent-length BEB cutaway bus. However, the number of ZEBs required may increase with time based on service requirements.

Table 8-2 presents a summary of VVTA's anticipated bus procurements through 2040. Years 2026 and 2029 are highlighted because these indicate when VVTA's new purchases should be 25 percent and 100 percent ZEBs, respectively.

Table 8-2. Summary of VVTA's Future Bus Purchases (through 2040)

		ZERO-EMISSION BUSES				CONVENTIONAL (CNG) BUSES			
YEAR	TOTAL BUSES	NUMBER	PCT.	BUS TYPE	FUEL TYPE	NUMBER	PCT.	BUS TYPE	FUEL TYPE
2020	**0**	0	0%	-	-	0	0%	-	-
2021	**2**	0	0%	-	-	2	100%	-	CNG
2022	**13**	0	0%	-	-	0	100%	-	CNG
2023	**0**	0	0%	-	-	0	0%	-	-
2024	**0**	0	0%	-	-	0	0%	-	-
2025	**5**	0	0%	-	-	0	0%	-	-
2026	**0**	0	0%	-	-	0	0%	-	-
2027	**4**	0	25%	Standard	BEB/FCEB	0	0%	-	-
2028	**13**	1	25%	Standard	BEB/FCEB	0	0%	-	-
2029	**1**	0	100%	Standard	BEB/FCEB	0	0%	-	-
2030	**9**	0	100%	Standard	BEB/FCEB	0	0%	-	-
2031	**12**	0	100%	Standard	BEB/FCEB	0	0%	-	-
2032	**16**	0	100%	Standard	BEB/FCEB	0	0%	-	-
2033	**1**	1	100%	Standard	BEB/FCEB	0	0%	-	-
2034	**5**	0	100%	Standard	BEB/FCEB	0	0%	-	-
2035	**0**	0	0%	-	-	0	0%	-	-
2036	**4**	0	100%	Standard	BEB/FCEB	0	0%	-	-
2037	**13**	0	100%	Standard	BEB/FCEB	0	0%	-	-
2038	**1**	1	100%	Standard	BEB/FCEB	0	0%	-	-
2039	**9**	0	100%	Standard	BEB/FCEB	0	0%	-	-
2040	**12**	0	100%	Standard	BEB/FCEB	0	0%	-	-

Note: All new purchases were assumed to have a useful life of nine or 14 years per FTA Circular 9030.1D, Ch. VI, paragraph 4.a.
Source: WSP, February 2020

8.2.5 ZEB RANGE REQUIREMENTS AND COSTS

VVTA has the longest distance blocks among all five operators, by both average and maximum. VVTA operates 64 weekday blocks, of which, 54 are longer than 100 miles. Its longest two blocks belong to Route 23 (525 miles), which serves Apple Valley. In all, VVTA has five blocks of greater than 400 miles, and all 10 of its longest blocks are greater than 350 miles. Depending on operational parameters, including operator behavior, ambient temperature, traffic, and ridership, these ranges may be unattainable or difficult to achieve on certain days. To reduce impacts to service, VVTA will consider a number of strategies to supplement onboard battery storage, including additional buses, midday charging, battery/charging management systems, and solar and battery storage. In future ZEB applications, VVTA may also consider FCEBs, especially if battery technology doesn't advance as forecasted. Table 8-3 presents the required range and estimated cost of ZEBs through 2040.

Table 8-3. Range and Estimated Costs of Future ZEB Purchases

YEAR	TOTAL ZEBS	BUS TYPES	REQUIRED RANGE (MI.)	ESTIMATED COST/BUS
2028	1	BEB	175	$1,000,000
2033	1	BEB	175	$1,000,000
2038	1	BEB	175	$1,000,000

Source: WSP, February 2020

8.2.6 ZEB CONVERSIONS

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

8.3 FACILITIES AND INFRASTRUCTURE MODIFICATIONS

The following sections detail the planned charging strategies, infrastructure, detailed base improvements, and program schedule.

8.3.1 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. For that reason, the recommended facility and infrastructure modifications are based on what can physically be accommodated at each facility. This is based on the number of existing vehicles plus a predetermined growth factor (or space at the division). This provides the agency with a ceiling for what can physically be constructed and at what cost. Service changes and bus movements may happen multiple times a year, for some agencies. By establishing a full build scenario, agencies can optimize, and tailor strategies based on existing (or anticipated) service for implementation.

The analysis of FCEBs at each agency is ongoing, however, a hydrogen storage footprint was established at each division where vehicles and space can support it. Further analysis (Master Plan and subsequent studies) will analyze alternatives of hydrogen delivery.

In the case of VVTA, the full build scenario is presented for context. However, refinements and tailored strategies will be developed in the Master Plan and future implementation studies.

8.3.2 FACILITY MODIFICATIONS

VVTA's transition to ZE technologies, namely, BEB, will require a number of modifications and changes to existing infrastructure and operations. This would include the enhancements and expansions of electrical equipment, additional electrical capacity, and the installation of BEB chargers, dispensers, and other components. These modifications will occur at VVTA's existing yard in Hesperia and future yard in Barstow.

Based on VVTA's existing service needs and site configurations, VVTA plans on installing ground-mounted plug-in chargers to support BEBs at both Hesperia and Barstow yards. The proposed full facility layout is based on utilizing a 150-kW DC charging cabinet used in a 1:2 charging ratio (one DC charging cabinet energizes two separate plug-in cord dispensers). This charger to dispenser ratio would meet the requirements to charge VVTA's fleet during the vehicles' servicing and dwell time on the site while minimizing the peak electrical demand.

Figure 8-3 illustrates the location of VVTA's yards and Table 8-4 summarizes the modifications and schedule of each base and the following sections detail the process of each base's transition from existing conditions to BEB-readiness.

Figure 8-3. VVTA's Yard Locations

Table 8-4. VVTA's Yard Summary

GARAGE	ADDRESS	MAIN FUNCTIONS	PLANNED INFRASTRUCTURE	EXISTING/REQ'D CAPACITY (MW)	UPGRADES REQ'D?	TIMELINE
Hesperia	171510 Smoke Tree St. Hesperia, CA	Fueling, Storage, and Maintenance	Plug-In Charging to support 104 buses by 2025	5 MW	Yes	2023-2028
Barstow*	100 Sandstone Court Barstow, CA	Fueling and Storage	Plug-In Charging to support 24 buses by 2025	5 MW	Yes	2023-2028

Note: Barstow Yard is currently under construction and anticipated to open in Spring 2020.
Source: WSP, February 2020

HESPERIA YARD

EXISTING CONDITIONS

Hesperia Yard is located at 171510 Smoke Tree Street in the City of Hesperia. The yard has an existing electrical capacity of XX MW with electrical service provided by (SCE).

Currently, 104 CNG-powered buses are stored, maintained, fueled, and serviced at the division. Hesperia Yard includes the following separate structures and major site areas: a two-story maintenance building, two-story transportation building, stand-alone wash building, stand-alone fuel building, employee parking lots, photovoltaic canopy-coverings in the bus parking and employee parking areas, and a CNG compressor yard with support equipment. Employee parking is on site in the employee parking lots along Smoke Tree Street.

Buses enter from Smoke Tree Street and park facing south in the yard before undergoing service. Individual buses are then taken by VVTA nightly service staff to the fuel lanes for fare retrieval and fueling before pulling forward to the bus wash lanes. The interiors of the buses are cleaned during the fueling process. After fuel and wash, buses are circulated back into the bus parking tracks and re-parked nose-to-tail in vertical tracks facing south under the bus parking canopy.

Bus parking tracks are located primarily under the photovoltaic solar canopy and are two-deep for 40-foot buses. ChargePoint Express 250 chargers are present in the first three rows along the western edge of the northern bus parking canopy. All bus parking tracks are approximately 12-foot wide and buses are not assigned to specific spaces outside of the BEBs being parked in the charger-equipped rows. The initial BEB transformer and utility equipment is present in the circulation space between the northern site wall and bus parking canopy.

Figure 8-4. Hesperia Yard - Existing Conditions

Note: Google Earth, February 2020

Figure 8-5. Hesperia Yard's Maintenance Bays

Note: WSP, February 2020

Figure 8-6. Hesperia Yard's ChargePoint Chargers and BEBs

Note: WSP, February 202050

PLANNED ZEB MODIFICATIONS

Based on the recommended ground-mounted DC plug-in charging solution, the Hesperia Yard is capable of parking 104 buses with 104 plug-in charging positions in a 1:2 charger to bus dispenser ratio.

Table 8-5 summarizes the ZEB infrastructure planned at the Hesperia Yard.

Table 8-5. Hesperia Yard Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY
VVTA	Hesperia Yard	Ground-Mounted; Plug-In	50	104	150 kW	Storage/ Delivery

Source: WSP, February 2020

In addition to the existing seven dispensers serving the seven northwest parking spaces under the existing solar canopy, the following BEB equipment and locations are proposed:

— 24 total charging cabinets distributed alternating in pairs or single units every three tracks on both the north and south side of the exiting northern solar bus parking canopy with 47 plug-in dispenser charging positions laid out to match the existing seven dispenser configuration.

— 26 total charging cabinets distributed alternating in pairs or single units every three tracks on both the north and south side of the exiting southern solar bus parking canopy with 50 plug-in dispenser charging positions laid out similar to the existing seven dispenser configuration on the northern canopy.

The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

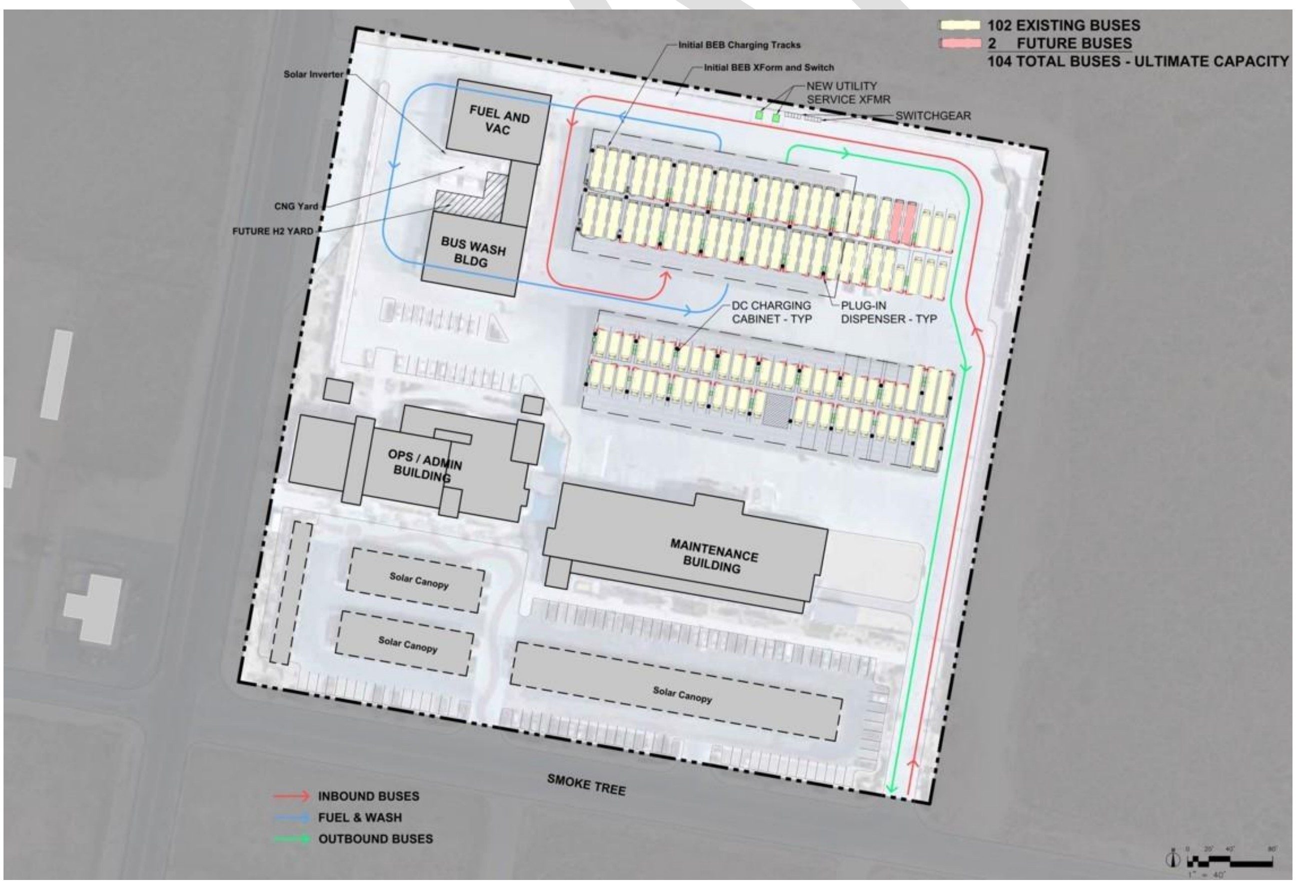
— Two medium voltage utility service transformers in the BEB utility yard in the open space north of the existing parking canopy.

— Two sets of switchgear in the BEB utility yard in the open space north of the existing parking canopy.

Hydrogen fueling for the routes unable to be completed with BEBs is recommended to be located in a portion of the existing CNG yard through the decommissioning of unused excess CNG compression and storage if commercially available hydrogen fueling stations are not utilized. WSP recommends utilizing a containerized hydrogen solution with hydrogen delivered to the site via tank truck and compressed on site to meet hydrogen fueling for the first FCEBs to be served. As hydrogen needs grow while CNG vacates the site, a larger hydrogen compression system can be considered for implementation.

Figure 6-5 illustrates the Hesperia Yard at full build-out.

Figure 8-7. Hesperia Yard – Full ZEB Build-Out



BARSTOW YARD

EXISTING CONDITIONS

The future Barstow Yard is currently in the early stages of construction at 100 Sandstone Court in the City of Barstow with an expected completion date in Spring 2020. The site is directly next to the existing Barstow Yard, a small operation and joint venture with the City of Barstow and Transdev. The future site will have electrical supply provided by (SCE).

The Barstow Yard will include the following separate structures and major site areas: a two-story combined maintenance and transportation building, stand-alone wash canopy, the existing CNG fueling site, employee parking lots, photovoltaic canopy-coverings in the bus parking and employee parking areas, and the existing CNG compressor yard with support equipment. Employee parking is on site in the employee parking lots along Main Street.

Buses will enter from Main Street and park facing southwest, two at a time, before undergoing service. Individual buses will be taken by VVTA nightly service staff to the existing fuel area adjacent to the site for fueling before reentering the site and entering the bus wash lanes. After fuel and wash, buses will be circulated back into the bus parking tracks and re-parked in the parking tracks. The interiors of the buses will be cleaned during the fueling process.

The new maintenance facility will be capable of accommodating BEBs. High-voltage welding outlets can be utilized for mobile plug-in chargers as required to energize buses in maintenance bays. Gas detection would require modification for hydrogen gas detection in the event that FCEBs are introduced at the facility. The existing CNG fueling station will remain on the site upon completion of the new yard.

Figure 8-8. Barstow Yard - Existing Conditions

Note: Google Earth, February 2020

Figure 8-9. Barstow Yard Existing CNG Facilities

Note: WSP, February 2020

PLANNED ZEB MODIFICATIONS

Based on the recommended ground-mounted DC plug-in charging solution, the Barstow Yard will be capable of parking 24 buses with 24 plug-in charging positions in a 1:2 charger to bus dispenser ratio.

Table 8-6 summarizes the ZEB infrastructure planned at the Barstow Yard

Table 8-6. Barstow Yard Supporting Infrastructure Summary

AGENCY	FACILITY	CHARGING STRATEGY	# OF CHARGERS	# OF DISPENSERS	CHARGER RATING	FCEB STRATEGY
VVTA	Barstow Yard	Ground-Mounted; Plug-In	12	24	150 kW	Storage/ Delivery

Source: WSP, February 2020

The following BEB equipment and locations are proposed:

— Five charging cabinets on the southern side of the northern grouping of bus parking spaces with 10 plug-in dispenser charging positions distributed every two tracks in the parking spaces.

— Seven charging cabinets on the southern side of the southern grouping of bus parking spaces with 14 plug-in dispenser charging positions distributed every 2 tracks in the parking spaces.

The plug-in charging dispensers and charging cabinets will be served by the following electrical infrastructure:

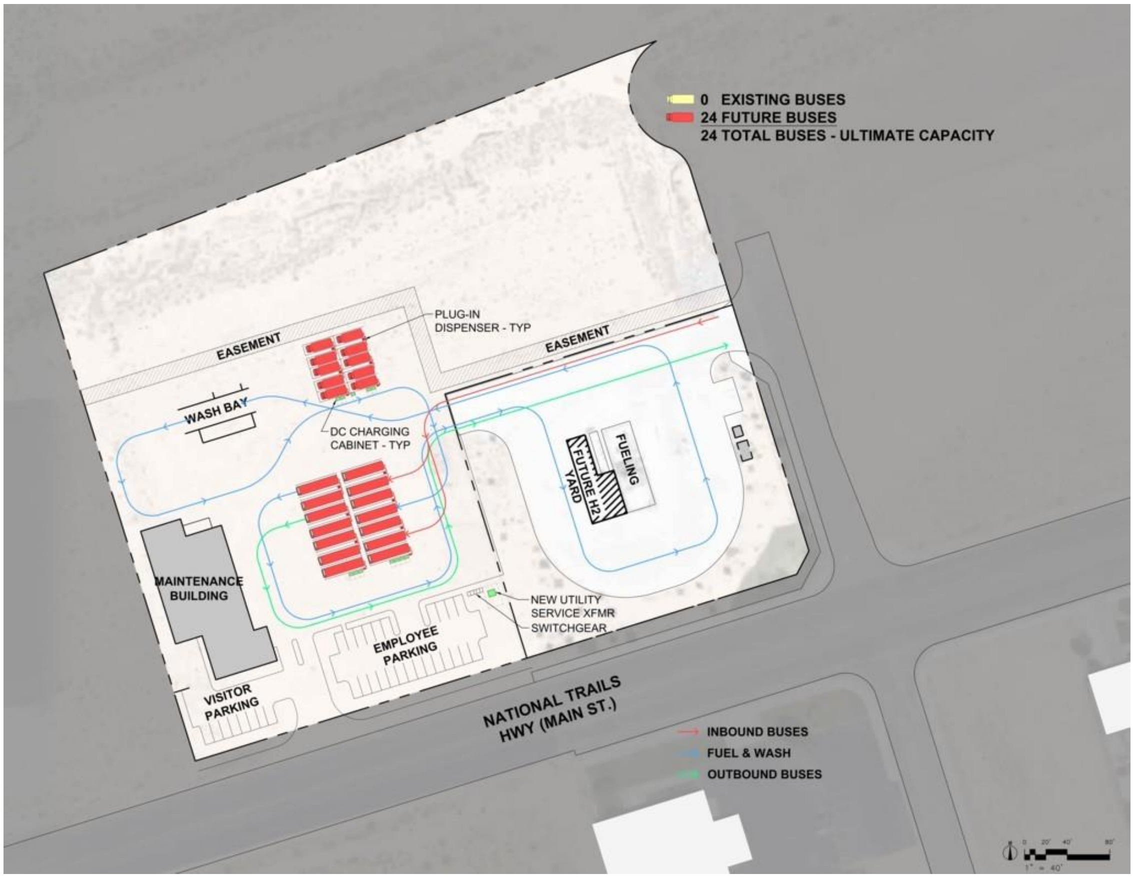
— One medium voltage utility service transformer in a new utility yard in the open space east of the employee parking lot and west of the CNG fueling circulation area.

— One switchgear in a new utility yard in the open space east of the employee parking lot and west of the CNG fueling circulation area.

Hydrogen fueling for the routes unable to be completed with BEBs is recommended to be adjacent to the existing CNG and LNG fueling currently present on the site. WSP recommends utilizing a containerized hydrogen solution with liquid hydrogen delivered to the site by tank truck/trailer and stored on site to meet hydrogen fueling for the first FCEBs to be served. As hydrogen needs grow, a larger hydrogen storage system can be considered for implementation.

Figure 8-10 illustrates the Barstow Yard at full build-out.

Figure 8-10. Barstow Yard – Full ZEB Build-Out



Source: WSP, February 2020

8.3.3 PHASING AND CONSTRUCTION SCHEDULE

Adhering to the construction schedule and milestones will be critical because the facilities' construction must be completed before buses are delivered, otherwise, the buses will not be able to operate. To accomplish this, construction for BEB-supporting infrastructure is expected to be done in phases to minimize disruption of operations. Both Hesperia and Barstow Yards are anticipated to be constructed in two phases.

Additional electrical capacity will be required to meet the service needs of buses at both yards. Construction and enhancements to bring this additional electrical capacity is anticipated to take three to five years based on electrical utilities' protocol. This timeframe would include method of service studies, design, and construction. It is recommended that electrical infrastructure such as transformers and switchgears be installed with the initial phase at both Hesperia and Barstow yards to avoid the disruption of ongoing charging operations.

The following provides details on recommended phasing for each yard.

HESPERIA YARD

PHASE 1

The recommended first phase of charger installation the for the Hesperia Yard site is to install all of the in-ground conduit to route electrical service from the expanded electrical yard to the northern parking canopy and continue charger and dispenser installation eastward from the existing seven chargers in the same pattern as the existing layout for a total of 47 charging positions. Trenching and conduit installation from the electrical yard to the northern parking canopy should also include the conduit for the southern parking canopy in this phase and have it terminate at the edge of the northern parking canopy. This will save on construction costs and allow for the southern charging positions to be deployed more rapidly in Phase 2 with less interruption to ongoing operations.

PHASE 2

Phase 2 at Hesperia Yard should perform yard trenching to distribute electrical service to the southern yard parking area from the terminated distribution in Phase 1 and install the islands to house the charging cabinets and dispensers for an additional 50 charging positions.

Hydrogen fueled vehicles are recommended for initial implementation during Phase 2 as a large portion of the CNG demand will have been reduced on the site. This will allow a partial phase-out of the CNG yard and equipment so that a containerized hydrogen solution with pre-compressed hydrogen on-site delivery can be installed in the partially decommissioned CNG area adjacent to the fuel island. Upon completion of Phase 2 and full CNG decommissioning on the site, the future hydrogen storage can be increased to meet any growth in demand and on-site compression can also be implemented if necessary or financially beneficial.

BARSTOW YARD

PHASE 1

WSP recommends completing all trenching and electrical distribution for electrical service to each dispenser position and its associated island on the entire site during the initial construction to avoid having to interrupt services once they begin at the Future Barstow Yard.

In Phase 1 an initial seven charging cabinets should be installed to serve 14 island-mounted plug-in dispensers in the southern parking spaces.

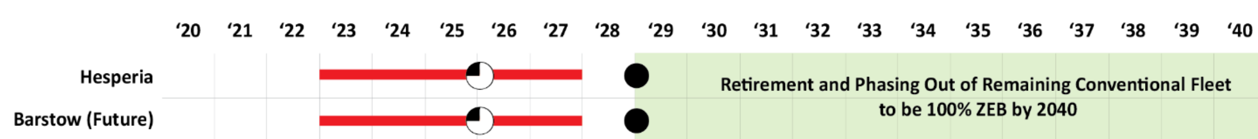
PHASE 2

Phase 2 at the Future Barstow Yard should complete the installation of the remaining five charging cabinets and 10 island-mounted plug-in dispensers in the northern parking spaces.

FCEBs can be implemented at the Future Barstow site during any phase via either the use of a containerized hydrogen storage and dispensing unit with pre-compressed hydrogen delivery on site adjacent to the existing CNG storage in the CNG fueling yard. Adequate space is immediately available to place a system on the west side of the existing CNG storage tanks. If required, future hydrogen storage can be increased to meet any growth in demand and on-site compression can also be implemented if necessary or financially beneficial.

Figure 8-11 presents the proposed construction schedule for VVTA's transition to ZEBs. The Harvey Balls indicate the percentage of new buses that need to be ZEB.

Figure 8-11. VVTA Construction Schedule



Note: WSP, February 2020

8.4 DISADVANTAGED COMMUNITIES

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, as 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.

8.4.1 VVTA'S DISADVANTAGED COMMUNITY ANALYSIS

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

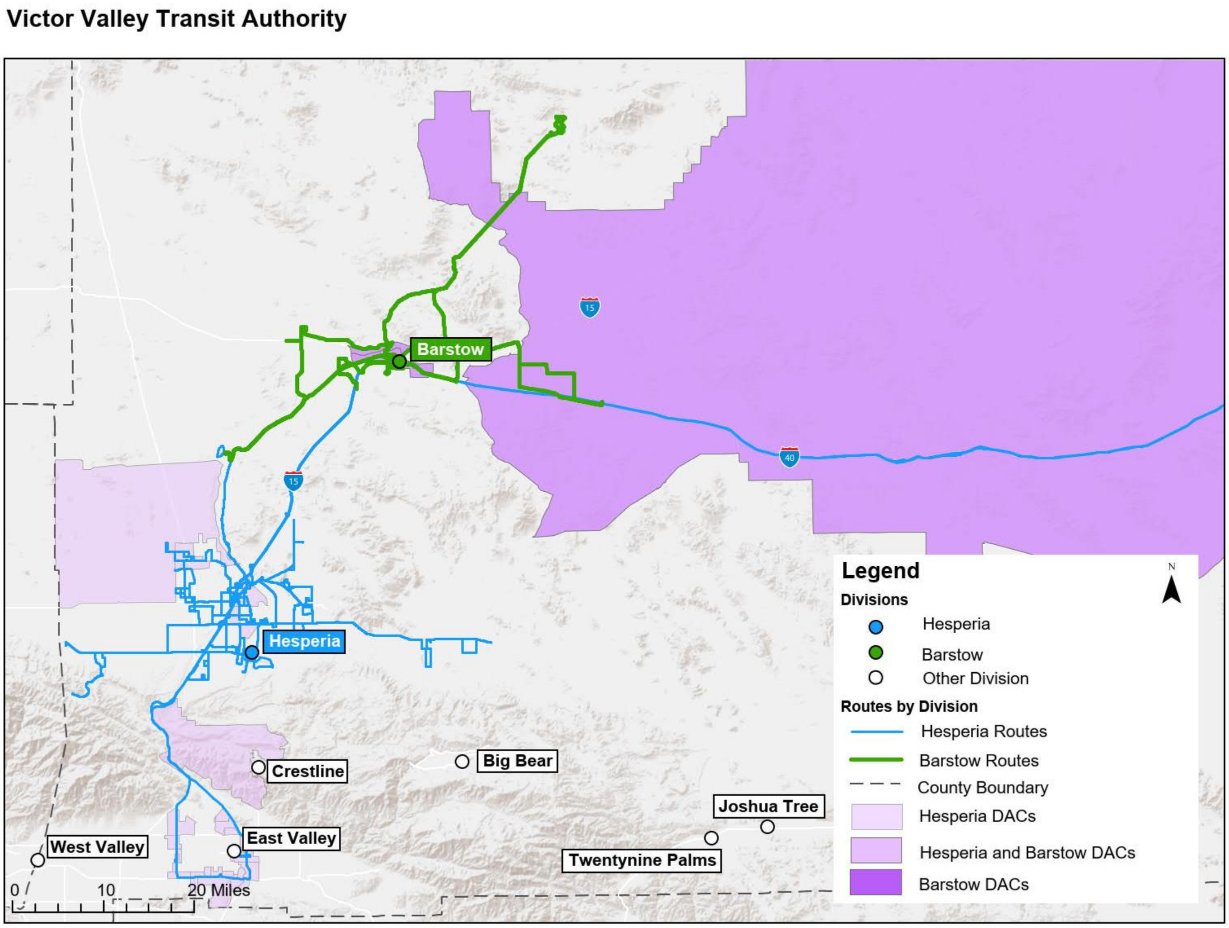
At this time, both the Hesperia Yard and the future Barstow Yard are located in areas considered "disadvantaged". Both yards also serve routes that traverse DACs. Hesperia Yard serves 95 communities, 37 of which (39 percent), are considered disadvantaged. Whereas, Barstow Yard serves 12 communities, 5 of which (42 percent), are considered disadvantaged.

Table 8-7 summarizes VVTA's yards and census tracts served in terms of DACs. Figure 8-12 illustrates VVTA's yards and the census tracts that they serve.

Table 8-7. VVTA's Disadvantaged Communities

BASE	IN DAC?	NOX EXEMPT AREA?	COMMUNITIES SERVED	DAC'S SERVED	PCT. OF DACS SERVED
Hesperia	Yes	Yes	95	37	39%
Barstow	Yes	Yes	12	5	42%

Figure 8-12. VVTA's Disadvantaged Communities



Source: CalEnviroScreen 3.0, February 2020

8.5 WORKFORCE TRAINING

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

8.5.1 TRAINING REQUIREMENTS

The transition to ZEBs will significantly alter Omnitrans' service and operations. Converting to ZEBs from diesel is an arduous endeavor and will impact all ranks of the organization. This will require extensive change management and training, some of which will be provided by the OEMs, others by Omnitrans and outside organizations. Training will need to be conducted well in advance of the delivery of the first buses and will be ongoing throughout the lifecycle of the technology.

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

Bus operators will need to be familiarized with the buses, safety, bus operations, and pantograph operations.

— Facilities Maintenance Staff and Maintenance
City 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.

— Body Repairers
Body repairers at the contracted operator will need to be familiarized with the safety-related features and other components of ZEBs.

— Instructors
Maintenance instructors will need to understand all aspects of the transition of ZEBs to train others.

— Service Attendants
Staff will become familiarized with proper charging protocol and procedures that are ZEB-specific.

— Management Staff
All Management will be familiarized with ZEB operations and safety procedures.

Table 8-8: VVTA's ZEB Training Summary

TRAINING PROGRAM/CLASS	PURPOSE OF TRAINING	NAME OF PROVIDER	NUMBER OF TRAINEES	TRAINEES' POSITIONS	TRAINING HOURS	TRAINING FREQUENCY	ESTIMATED COSTS PER CLASS

8.6 COSTS AND FUNDING

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

8.6.1 PRELIMINARY COSTS

As expected, the cost of ZEB adoption is going to be very expensive. While actual costs (capital and operations & maintenance) of the transition are still being determined and evaluated, it is assumed that a full transition for just the buses and chargers (based on existing conditions) will cost approximately $39.7 million (in 2020 dollars). This assumes of approximately $100K and $50k for charging equipment (DC cabinets and dispensers) and support equipment (conduit, trenching, cabling, etc.), respectively, per bus. This also includes an assumed cost of $500K per bus, however, this will vary depending on length, customizations, etc.

8.6.2 POTENTIAL FUNDING SOURCES

There are a number of potential Federal, State, local, and project-specific funding and financing sources at Omnitrans' disposal. Omnitrans will monitor funding cycles and pursue opportunities that yield the most benefits for the agency pursuant to the ICT regulation. The following table identifies the many funding opportunities that Omnitrans may take advantage of in the next 20 years.

Table 8-9. ZEB 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
	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

Source: WSP, February 2020

8.7 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 VVTA has identified. The following sections briefly describe some of the challenges that VVTA faces for its transition.

- **Range issues.** VVTA has some blocks that exceed current BEB range. This means that VVTA will have to consider the following strategies to reduce or avoid service disruptions:
  - **Buy more buses.** This can assist with service requirements; however, more buses will require more chargers, more space at the division, and potentially higher utility costs.
  - **Opportunity charging.** This strategy could potentially reduce the costs (per bus) due to a smaller battery requirement, however, it would result in more capital infrastructure and utility costs.
  - **Service changes.** This would require the manipulation of block structure. While the riders may not notice the change, the agency will have to consider the potential impacts to operator and maintenance costs.
- **Technological adaptation (FCEB, BEB, or both?).** Currently, VVTA is modeling and planning for a transition based on existing service and ZEB technology. With the 2040 deadline looming, it is difficult to anticipate future technological enhancements and changes, such as improved batteries and chargers. Slight changes in these technologies could improve bus ranges, in turn, reducing costs. VVTA (and the market) has to be aware of these changes as it would be counterproductive to invest in technologies that will soon be outdated.
- **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. VVTA 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.
- **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, however, it will also make it challenging to meet ZEB goals for agencies if supply of buses can meet with demand.

9 NEXT STEPS

As mentioned, the process to transition to ZEBs should and will be iterative to minimize risk, but also to accommodate new developments in a rapidly evolving market. SBCTA will use the information outlined in both the Rollout Plan and its ZEB Transition Master Plan to identify and further refine the following:

— **BEB and/or FCEB fleet mix at each agency.** Both the Rollout Plan and the Master Plan addresses each agency's specific needs and policy choices well as making determinations about what is feasible for each. VVTA has made it clear that it is very interested in FCEBs, for example, due to concerns about range and length of its service blocks and its own experience with ZEB implementation to date. The recommendations contained herein address what this consultant team believes is the most feasible and cost-effective means of implementing the mix of ZEB types at each agency. However, all agencies will have to re-address these issues and determine whether these recommendations regarding feasibility based on costs, service requirements, and availability have changed as each agency implements its transition toward ZEBs.

— **Addressing incomplete service blocks.** The consultant team's analysis has revealed that many blocks cannot be completed when considering BEBs and FCEBs, meaning, agencies will have to determine if they're going to file exemptions, purchase additional buses, restructure service to suit technological limitations, or invest in opportunity charging. These choices are rooted in each agency's own policies and plans outside of ZEB considerations. Because the smaller agencies have the option of submitting its own rollout plan before July 1, 2023, it could elect to wait to follow the rapidly developing technology trends to determine if newly available technologies can meet longer range needs; of course, the ability file an exemption remains. It is not recommended by this team to restructure routes based on range challenges or to

— **Costs.** Construction, capital, operating, and maintenance costs vary based on a number of factors. It will be important to get an understanding of the up-front costs and lifecycle costs and savings of investing in ZEBs. The consultant team is developing such cost estimates and each agency will need to revisit these estimates to determine if pricing has changed and make implementation changes, such as changes in their purchasing schedules, accordingly.

— **Collaboration Opportunities.** Whether purchasing things via CalACT or strategizing on a joint agreement for opportunity charging, agencies can continue maximize their outcomes by engaging with other regional and local agencies. It important for all agencies to continue to participate in groups such as the ZEBRA working group, California Transit Association and the state's chapter of the Association for Commuter Transportation (ACT), the American Public Transportation Association's Bus Technology Committee and other industry working groups.

— **ICT regulation compliance and subsequent implementation.** Only one of the five Operating Agencies with the County (OmniTrans) is required to submit a Rollout Plan by July 1, 2020. The others have the option to submit such a plan by the smaller fleet date of July 1, 2023. It is recommended that they do so, in order to monitor technology trends, market availability of new buses such as cutaways with ZE propulsion expected to come into the bus market, fuel and electricity pricing trends and the impact of contemplated service changes on these agencies' ZEB Rollout Plans. Should the County elect to file a Countywide Rollout Plan, it has the option of doing so by transmitting such an intention to CARB by no later than July 1, 2022, which satisfies the one-year notice requirement of the ICT Rule in time for submittal by the July1, 2023 date for the smaller operators. At that time, it can also notify CARB that OmniTrans' Rollout Plan will be amended such that it will join the Countywide Plan.

Moreover, as with any major capital plan and infrastructure program, it is important to note that as steps to implement the Rollout Plan and Master Plan, this analysis is only the beginning. Much more will be required as each agency procures buses and engages firms to design and build the needed infrastructure, and to ensure these steps remain the most cost-effective options with respect to their impacts on service operation and maintenance. Finally, while the team listed a variety of funding sources, each agency must tailor its grant funding applications based on its own needs and resources.

While the Rollout Plan and Master Plan documents have such limitations, represent more than a snapshot it time, however. Rather, they are "future-proofed" as much as possible based on the team's knowledge of technology and cost trends to date. Moreover, they are intended to be guides on how best to implement a ZEB transition. It thus remains up to each agency to decide how best to use these recommendations.