GOLDEN EMPIRE TRANSIT DISTRICT

Zero Emission Bus Rollout Plan

Contents

Abbreviations

AC	Alternating Circuit
ADA	Americans with Disabilities Act
BEB	Battery Electric Bus
CalSTA	California State Transportation Agency
Caltrans	California Department of Transportation
CapEx	Capital Expenditure
CARB	California Air Resource Board
CNG	Compressed Natural Gas
CO	Carbon Monoxide
DC	Direct Circuit
ESS	Energy Storage System
FC	Fuel Cell
FCEB	Fuel Cell Electric Bus
FR	Fixed Route
FTA	Federal Transit Administration
GET	Golden Empire Transit
GHG	Greenhouse Gas
GHG	Greenhouse Gas
H_2	Hydrogen
HVIP	Hybrid and Zero-Emission Truck and Bus-Voucher Incentive Project
ICT	Innovative Clean Transit
Kg	Kilogram
kW	Kilowatt
kWh	Kilowatt Hour
LCFS	Low Carbon Fuel Standard
Mi	Mile
Mph	Miles per Hour
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NFPA	National Fire Protection Association
NOx	Oxides of Nitrogen
OEM	Original Equipment Manufacturer
OpEx	Operating Expenditure
PG&E	Pacific Gas and Electric
PM	Particulate Matter
PT	Paratransit
VAC	Volts of AC Power
VOC	Volatile Organic Compounds
VW	Volkswagen
ZEB	Zero Emission Bus

A. Transit Agency Information

The Golden Empire Transit District (GET) is the primary public transportation provider for the Bakersfield Urbanized Area. Its service territory spans 160 square miles including all the area within the Bakersfield city limits as well as adjacent unincorporated areas. GET operates 14 fixed routes, 1 limited route, and 1 express route as well as paratransit services for Americans with Disabilities Act (ADA)-eligible persons and microtransit service.

GET's current fleet is comprised of 85 compressed natural gas (CNG) fixed route buses and 22 CNG paratransit vehicles. All of the fixed route vehicles are standard 40-foot transit buses. The paratransit fleet consists of a combination of cutaway buses and vans, which are all wheelchair accessible. The average age of the fixed route and paratransit vehicles are 6.7 and 3.5 years, respectively.

All of GET's services operate out of a single operations / maintenance / administrative facility at 1830 Golden State Avenue in Bakersfield, California. In the coming years, GET may be required to relocate this facility as a result of the California High Speed Rail Authority Project. The plan was developed taking into account the implications of a potential relocation. The bus and infrastructure adoption schedules are phased so that the equipment can be moved to the new facility if necessary.

Transit Agency's Name	Golden Empire Transit District
Mailing Address (number, street, city, county, zip code)	1830 Golden State Avenue Bakersfield, CA 93301
Name of Transit Agency's Air District(s)	San Joaquin Valley Air Pollution Control District
Name of Transit Agency's Air Basin(s)	San Joaquin Valley Air Basin
Total number of buses in Annual Maximum service	69
Population of the urbanized area a transit agency is serving as last published by the Census Bureau before December 31, 2017	500,977
Contact information of the general manager, chief operating officer, or equivalent: A) Contact Name (Last Name, First Name, MI) B) Title C) Phone Number D) Email	King, Karen CEO 661-324-9874 kking@getbus.org

B. Rollout Plan General Information

The GET Zero-Emission Bus (ZEB) Rollout Plan is designed to transition the agency's bus fleet to 100% zero-emission by 2040 in accordance with the Innovative Clean Transit (ICT) regulation. Completing this transition results in significant air quality and health benefits for local residents and GET staff.

GET is taking steps to begin the transition earlier than required by the regulation. This will enable the agency to generate bonus credits, reducing the number of ZEBs that are required to be purchased between 2023 and 2029. Since there is uncertainty about whether, where, and when GET will have to relocate, keeping the ZEB fleet relatively small during this time will reduce the amount of fueling and support infrastructure that would need to be moved if the facility is relocated. It will also reduce the financial burden to the agency.

The final composition of the fixed route fleet will be 100% fuel cell electric buses (FCEBs). Modelling analysis found that a small percentage of the routes currently operated by GET could be satisfied by battery electric buses (BEBs) as a 1:1 BEB:CNG bus replacement. However, operating one type of vehicle offers significant benefits to the agency as all buses can be operated and maintained efficiently and economically. It also means the buses are interchangeable and can be dispatched on any route as required. The methodology and analysis supporting this composition is further described in Section C.

The final composition of the paratransit fleet will be 100% BEBs utilizing depot charging at a single location. Paratransit FCEBs are not currently commercially available and will likely lag in development and deployment compared to BEBs. The only option for ZEB paratransit vehicles in the near-term may be BEBs and deploying FCEBs will likely involve participating in early technology trials, which have a higher risk of equipment failure. GET will evaluate options as new ZEB paratransit models become available because the limited range of BEBs may limit their potential for deployment. Also, GET's current facility does not have sufficient electrical capacity to supply charging infrastructure for a fleet of buses. Deploying BEBs will require either the installation of additional electrical capacity at GET's current location, or if the facility is relocated, that the new location has sufficient electrical capacity.

GET is pleased to present this plan and demonstrate the agency's leadership in transitioning to a sustainable model of transit operation.

This ZEB Rollout Plan was approved by the GET Board of Directors on August 18, 2020 under Resolution 2020-13. The board approved resolution is attached in Appendix B.

This Rollout Plan was developed by the LeFlore Group and Zen and the Art of Clean Energy Solutions (Zen) in collaboration with GET.

For additional information on the Rollout Plan, please contact:

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661-324-9874

C. Technology Profile

When the fleet is transitioned to 100% zero-emission, GET will have a fixed route fleet of 84 FCEBs and a paratransit fleet of 22 BEBs. The final composition was determined based on an analysis of GET's route requirements and the commercially available ZEB models, while minimizing capital expenditures.

Route Analysis

Fixed Route Fleet

GET is planning to continue operating its existing routes and intends to replace each bus on a one to one basis such that each decommissioned CNG bus is replaced by a ZEB capable of servicing its designated routes. At the same time, GET aims to build in operational flexibility, where buses are capable of running multiple routes in the event of unplanned maintenance or service disruptions. Based on this principle, opportunity charging BEB's that require fixed on-route charging infrastructure were not considered in the analysis.

The distance and topography constraints of GET's current routes were analyzed to determine the number of routes that can be satisfied by FCEBs or BEBs. The possible range of several commercially available BEBs and FCEBs were estimated using Zen's proprietary kinetic model which analyzes fuel or electricity consumption for a given duty cycle. It was not possible to obtain duty cycle data from buses operating on GET's routes, so representative routes were used based on other California agencies. The model accounts for route specific factors including speed, idling times, auxiliary load, and elevation changes.

Table 1 and Table 2 show the ZEBs that were modelled to estimate range.

Table 1: Commercial BEBs incorporated into route analysis

Bus Specification	BYD	New Flyer	Proterra		
	40' K9	40' XCE Charge	40' XR Duo	40' E2 Duo	40' E2 Max
Electric Motor Power (kW)	300	160	380	380	380
Energy Storage Power (kW)	300	160	252	380	280
Energy Storage Capacity (kWh)	324	388, 466	220	440	660

Table 2: Commercial FCEB models incorporated into route analysis

Bus Specification	ElDorado	New Flyer
	National 40' AXESS	XCE 40' Charge
Electric Motor Power (kW)	200	160
Energy Storage Power (kW)	200	160
Energy Storage Capacity (kWh)	11.2	100
Fuel Cell Engine Power (kW)	150	85

Figure 1 displays an example duty cycle for a representative route. Figure 2 and Figure 3 show the modelled power demand and vehicle's fuel consumption (represented as energy storage system (ESS) state of charge (SOC) for a BEB and remaining hydrogen storage for an FCEB) operating on the duty cycle displayed in Figure 1, respectively.

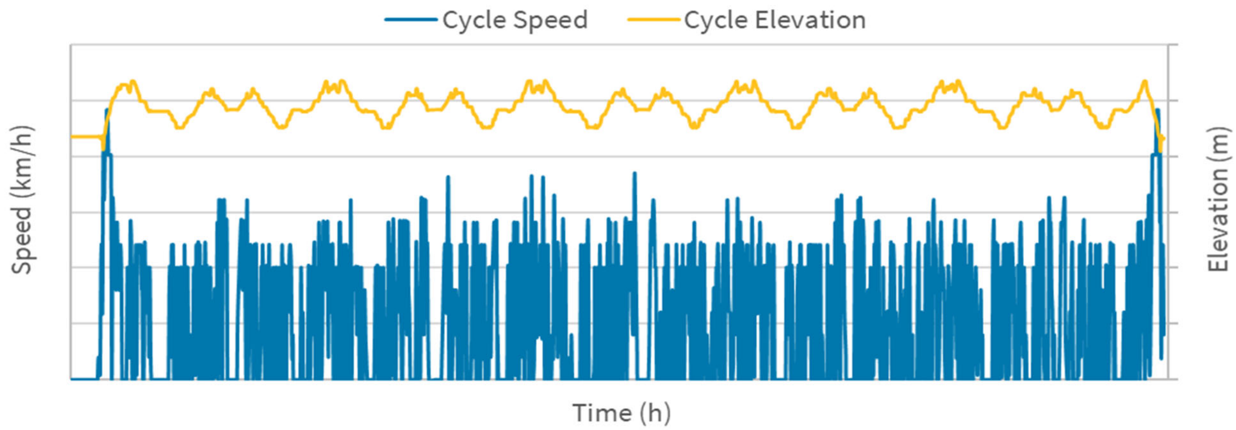


Figure 1: Example duty cycle analysis

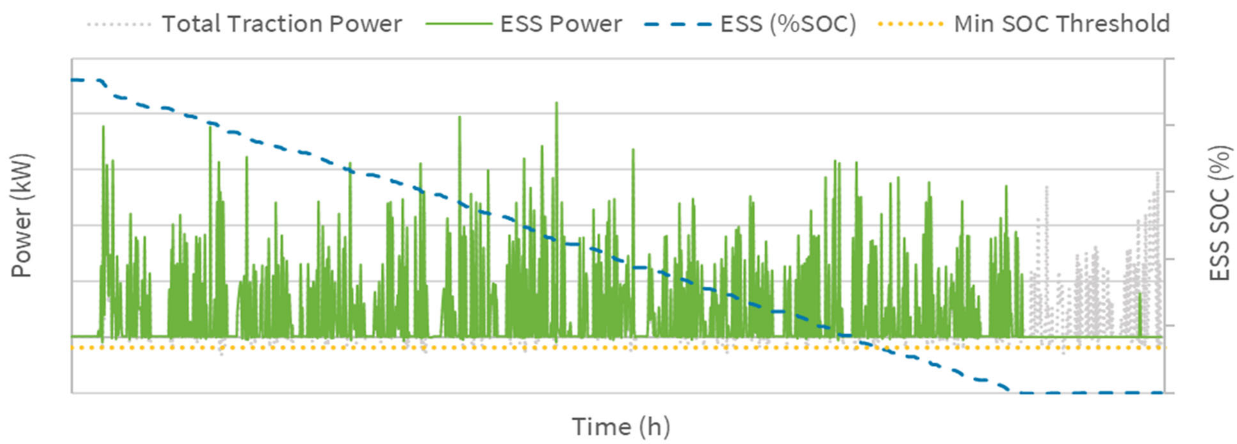


Figure 2: BEB kinetic modelling output

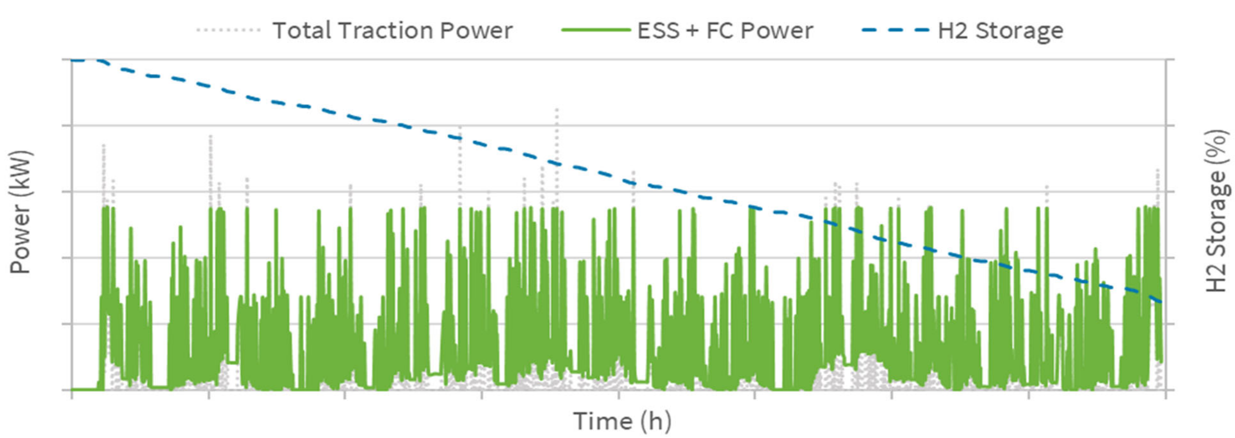


Figure 3: FCEB kinetic modelling output

The range of each vehicle can be estimated as the distance at which the vehicle fuel capacity has gone below a minimum threshold. For example, the BEB displayed in Figure 2 indicates that the bus has used 100% of its energy storage system (ESS) capacity before the route is complete, whereas, the FCEB in Figure 3 still has hydrogen available when the route is complete.

As such, the ZEB technology required for each block at GET was determined based on the calculated range threshold for each technology and whether a route undergoes challenging terrain such as going up large hills. The final route analysis determined that 11 out of 70 blocks could be satisfied by BEBs, while the remainder must be serviced by FCEBs. To satisfy these blocks, 13 out of 84 buses could be BEBs, while the remainder must be FCEBs to maintain service using a 1:1 bus replacement for new ZEBs.

Paratransit Fleet

Table 3 below details the ZEB paratransit models that were considered for this analysis. There is currently limited operational and performance data available for zero-emission paratransit vehicles. In performing this analysis, it was assumed that paratransit BEBs would be capable of replacing CNG vehicles as a 1:1 replacement. GET plans to purchase BEBs because paratransit FCEBs are at an earlier technology readiness level than BEBs and deploying early stage technology increases the risk of greater downtime and cost. GET will revaluate paratransit ZEB options (both fuel cell and battery) as they become available and may revise this plan before the first planned purchase in 2026.

Table 3: BEB paratransit vehicle specifications

Bus Specification	Motiv Power Systems	Lightning Systems
Bus Platform	Ford E-450	Ford E-450
Battery Capacity (kWh)	106	86, 129
Range (mi)	85	80, 120
Peak Motor Power Rating (kW)	150	180
Max Speed (mph)	65	65
100% Charging Time (hours) – Level 2	8	11.25, 16.75 (DC charge – 1.5, 1.75)

Transition Cost Scenario Analysis

Based on the operational constraints of the route analysis, two scenarios were evaluated to compare the required operating (OpEx) and capital expenditures (CapEx) and select the ideal option for GET. The scenarios are:

Scenario A: Mixed fleet with 71 FCEBs and 13 BEBs fixed route buses, and 22 paratransit BEBs

Scenario B: Full FCEB fixed route fleet with 84 FCEBs and 22 paratransit BEBs

Scenario A

As shown in Figure 4, the total transition cost for this scenario is $286 million (non-discounted net costs). The capital expenditures were based on budgetary estimates provided by OEMs and infrastructure vendors. The electrical charging infrastructure will require approximately 1.4 MW of continuous power for overnight charging of the fixed route and paratransit BEBs, and the OpEx includes the revenue from LCFS credits from both FCEB and BEB operation.

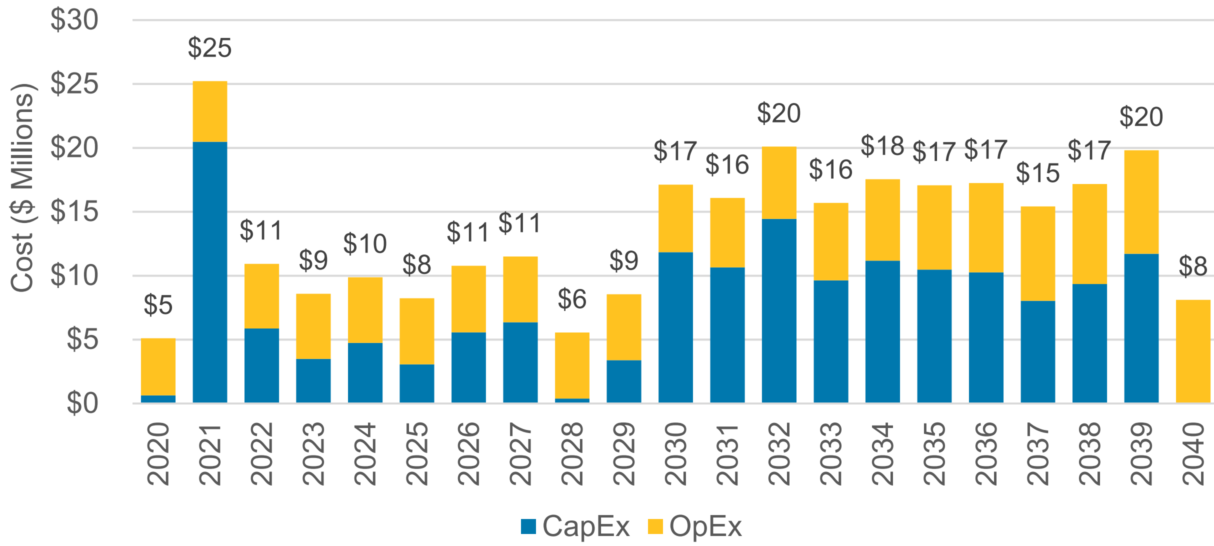


Figure 4: Scenario A (mixed fleet) costs analysis

Figure 5 shows the gradual scale up of the hydrogen fueling infrastructure in relation to the FCEBs service capacity. The solid blue line represents projected hydrogen demand based on GET's current route requirements, while the dashed line represents the maximum fueling capacity of the station. Since GET may alter routes in the future and the FCEB fuel efficiencies may change over time, the offset between the demand and available capacity acts as a safety factor in the infrastructure's design.

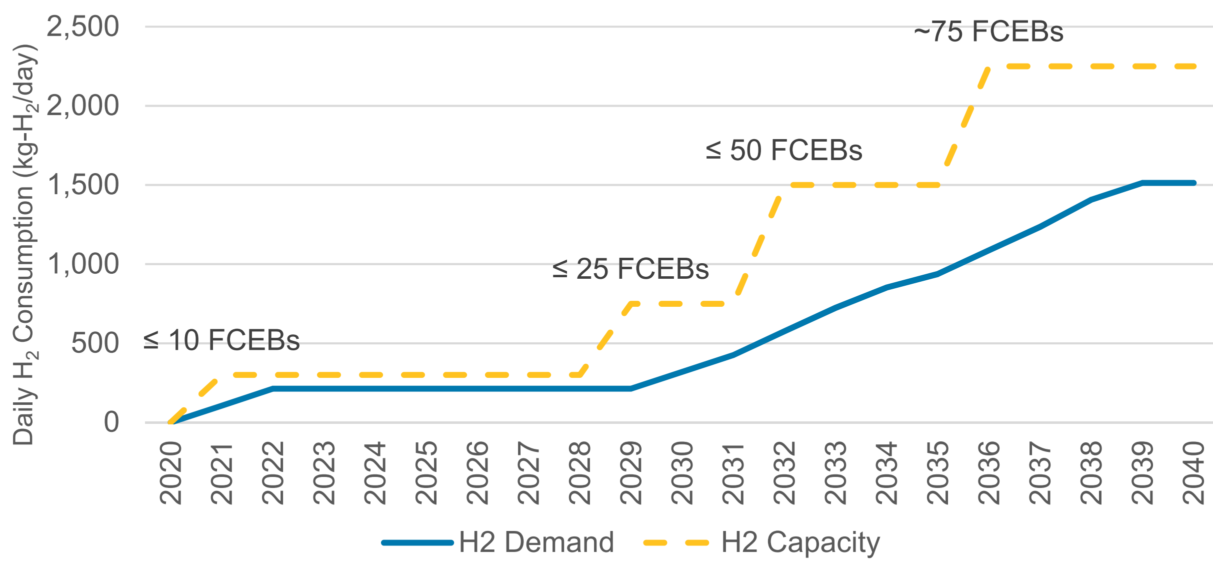


Figure 5: Scenario A (mixed fleet) hydrogen fueling capacity analysis

Scenario B

Figure 6 shows the total transition cost of an 100% FCEB fixed route fleet to be $292 million (non-discounted net costs). Although the total cost is 2.1% more than the mixed fleet costs, this approach provides GET with better operational flexibility, since each bus will be capable of operating on all routes due to the longer range of FCEBs compared to BEBs. This contrasts with Scenario A, where 13 buses must be limited to the shorter routes and cannot be used to fill in for a longer route in the event of unexpected downtime. Since the fueling time for FCEBs typically range from 10-15 minutes and the fueling procedure is similar to CNG bus fueling, this scenario minimizes the impact on GET's daily operational schedule, as opposed to changing staff schedules to accommodate for overnight electrical depot charging for BEBs.

The capacity required for overnight depot charging of the paratransit BEBs also decreases to approximately 0.4 MW, assuming the largest commercial model with a 129-kWh battery. This is critical for GET since there is currently very little available capacity at their facility, so any expansion could be costly.

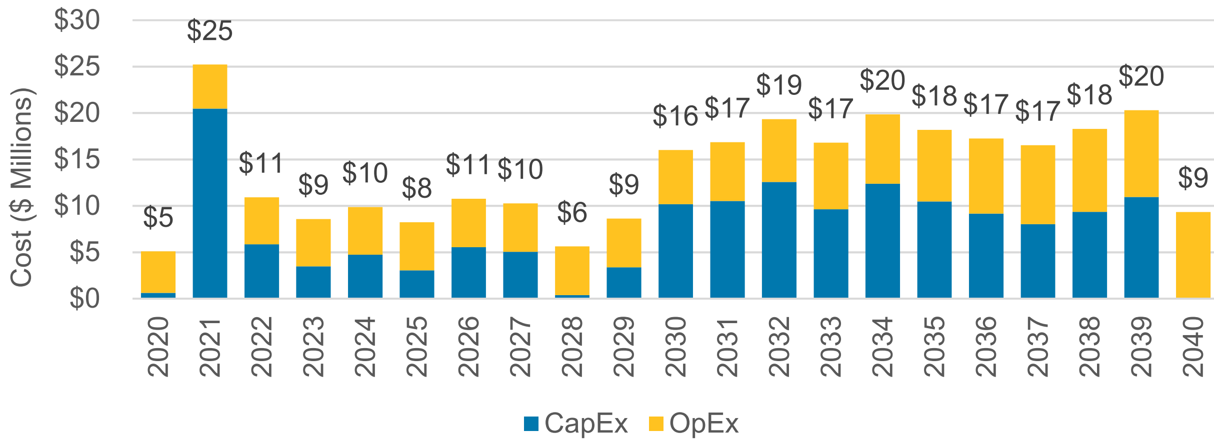


Figure 6: Scenario B (fuel cell fleet) costs analysis

Figure 7 shows the stepwise hydrogen infrastructure deployment for Scenario B.

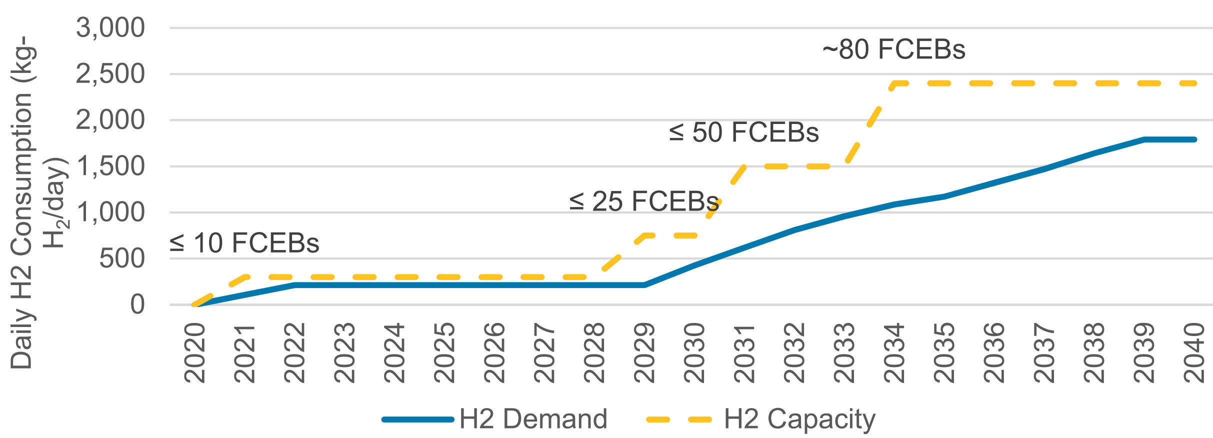


Figure 7: Scenario B (fuel cell fleet) hydrogen fueling capacity analysis

Figure 8 shows the discounted costs for the Scenarios A and B based on a weighted average cost of capital of 10%. This analysis considers the time value of money and indicates the increased cost of the 100% FCEB fixed route fleet is only 0.8% greater than the mixed fleet scenario. These numbers do not include the improved operational efficiencies by having a single technology type, which will translate to a financial benefit that is expected to be greater than the 0.8% increase in cost. It will also make fueling and maintenance logistics simpler and easier.

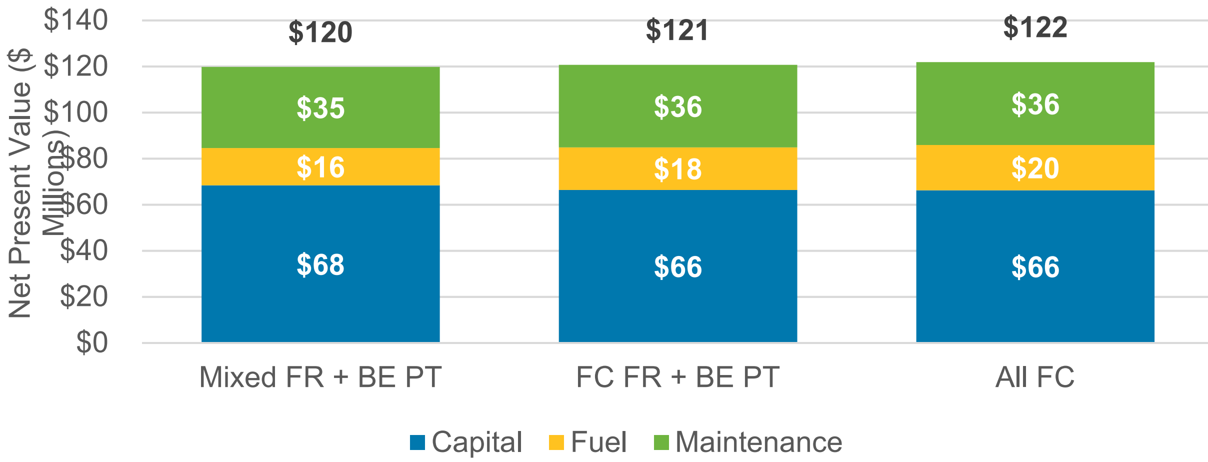


Figure 8: Total fixed route (FR) and paratransit (PT) fleet transition cost analysis for each scenario

Infrastructure Constraints

GET's facility is located at 1830 Golden State Ave in Bakersfield and hosts the overnight parking, maintenance, and fueling infrastructure for both the fixed route and paratransit fleets. The facility is close to its maximum electrical supply capacity and will require infrastructure upgrades for any additional loads. The facility is space constrained, with the site hosting 85 fixed route and 22 paratransit buses. Currently, the bus fleet parking lot is near capacity at night.

GET is in the process of evaluating potential relocation sites because of the California High Speed Rail Authority Project. Any new site would be required to meet operational requirements such as:

1. Available electrical capacity
2. Sufficient space for parking
3. Suitable area for siting of hydrogen fueling storage and fueling station sized to fuel 84 fixed route FCEBs in 8 hours
4. Suitable area for CNG dispensing and storage
5. Available area for construction of new maintenance facility

For the purposes of planning, it has been assumed that if a move is required, it would take place in 2025, which is the best available estimate. To account for this uncertainty, two scenarios were considered:

Scenario 1: GET selects a site and relocates in 2025

Scenario 2: GET remains at its current location indefinitely

The infrastructure upgrade requirements and timeline for both scenarios 1 and 2 are explained in-depth in Section E.

D. Current Bus Fleet Composition & Fleet Bus Purchases

Current Bus Fleet Composition

Fixed Route

GET's fixed route fleet is composed of 85 standard New Flyer 40' CNG buses. The average age of GET's fixed route fleet is 6.7 years, with vehicles ranging from 2 – 10 years. GET's fixed route service requires 69 operated vehicles at maximum service, resulting in a 19% spare ratio. Table 4 displays GET's current fixed route fleet inventory grouped by purchase year and bus type.

Table 4: Individual bus information of current fixed route bus fleet

# of Buses	Bus Model Year	Fuel Type	Bus Type
24	2018	CNG	New Flyer XN40
15	2013	CNG	New Flyer XN40
12	2012	CNG	New Flyer C40LFR
2	2011	CNG	New Flyer C40LFR
32	2010	CNG	New Flyer C40LFR

Paratransit

GET's paratransit fleet consists of 22 CNG cutaway vehicles. The average age of their fleet is 3.5 years, with vehicles ranging from 2 – 6 years old. At GET, the typical expected useful life for these vehicles is 7 years. GET's paratransit fleet categorized by procurement year and fuel type is summarized by Table 5.

Table 5: Individual bus information of paratransit bus fleet

# of Buses	Bus Model Year	Fuel Type	Bus Type
8	2018	CNG	Startrans Senator E450
1	2018	CNG	Starcraft Allstar E450
1	2018	CNG	Elkhart ECII E450
5	2016	CNG	Startrans Senator E450
2	2016	CNG	Elkhart ECII E450
5	2014	CNG	Elkhart ECII E450

Future Bus Purchases

The replacement schedule of GET's fixed route and paratransit fleets was created to ensure no vehicles are retired early and to meet compliance with the ICT Regulation. The fixed route fleet is projected to reduce in size by one bus over this period and the paratransit fleet is projected to remain the same size. This is consistent with GET's current plans based on route planning and expected ridership. Table 6 displays future purchases based on fuel type, bus type, and procurement year.

Table 6: Future bus purchases

Timeline (Year)	Total Purchased	ZEB Purchases				Conventional Bus Purchases			
		No.	%	Bus Type	Fuel Type	No.	%	Bus Type	Fuel Type
2020	5					5	100 %	Cutaway	CNG
2021	28	5	18%	Standard	FC	21	75%	Standard	CNG
						2	7%	Cutaway	CNG
2022	10	5	50%	Standard	FC	5	50%	Cutaway	CNG
2023	6					6	100 %	Standard	CNG
2024	8					8	100 %	Standard	CNG
2025	10					10	100 %	Cutaway	CNG
2026	9					9	100 %	Standard	CNG
2027	12	3	25%	Cutaway	BEB Depot	7	58%	Standard	CNG
						2	17%	Cutaway	CNG
2028	2	1	50%	Cutaway	BEB Depot	1	50%	Cutaway	CNG
2029	5	5	100 %	Cutaway	BEB Depot				
2030	9	9	100 %	Standard	FC				
2031	9	9	100 %	Standard	FC				
2032	19	9	47%	Standard	FC				
		10	53%	Cutaway	BEB Depot				
2033	9	9	100 %	Standard	FC				
2034	14	9	64%	Standard	FC				
		5	36%	Cutaway	BEB Depot				
2035	11	9	82%	Standard	FC				

		2	18%	Cutaway	BEB Depot				
2036	**12**	7	58%	Standard	FC				
		5	42%	Cutaway	BEB Depot				
2037	**7**	7	100 %	Standard	FC				
2038	**8**	8	100 %	Standard	FC				
2039	**18**	8	44%	Standard	FC				
		10	56%	Cutaway	BEB Depot				

Table 7 shows the estimated cost per year and required BEB range or on-board hydrogen storage for each future ZEB purchase. The costs were estimated based on the estimates provided by bus manufacturers and future cost trends projected by the California Air Resources Board (CARB).[1]

Table 7. Range and estimated cost of future ZEB purchases

Year	Total No. ZEBs	No. Type	Bus Type(s)	Required Range [Miles]	Estimated Cost of Each Bus
2021	**5**	5	Standard	300	$1,130,000
2022	**5**	5	Standard	300	$1,070,000
2027	**3**	3	Cutaway	150	$236,148
2028	**1**	1	Cutaway	150	$235,868
2029	**5**	5	Cutaway	150	$235,925
2030	**9**	9	Standard	300	$1,040,000
2031	**9**	9	Standard	300	$1,060,000
2032	**19**	9	Standard	300	$1,080,000
		10	Cutaway	150	$241,706
2033	**9**	9	Standard	300	$1,100,000
2034	**14**	9	Standard	300	$1,120,000
		5	Cutaway	150	$247,482
2035	**11**	9	Standard	300	$1,130,000
		2	Cutaway	150	$250,513
2036		7	Standard	300	$1,150,000

[1] State of California Air Resources Board. (2018). Staff Report: Initial Statement of Reasons - Public Hearing to Consider the Proposed Innovative Clean Transit Regulation A Replacement of the Fleet Rule for Transit Agencies: Appendix K. Retrieved from https://www.arb.ca.gov/regact/2018/ict2018/appk-statewidecostanalysis.xlsx?_ga=2.48303334.1749999270.1571069223-138148794.1501775822

	12	5	Cutaway	150	$253,641
2037	7	7	Standard	300	$1,180,000
2038	8	8	Standard	300	$1,200,000
2039	18	8	Cutaway	150	$1,220,000
		10	Standard	300	$263,630

Conventional Bus Conversions

GET is not planning on converting any conventional buses in service to zero-emission buses, but rather the transition plan is based on new purchases of ZEBs only. Fuel cell and battery electric bus conversions are uncommon and have tended to demonstrate lower availability and reliability than purpose built buses.

Fixed Route

GET's fixed route fleet transition plan will introduce ZEBs in accordance with the ICT Regulation by using bonus credits accumulated from ZEB purchases prior to 2023. The fleet transition technology and schedule are based on constraints associated with their service routes, and their potential site relocation in 2025. A lifetime of 12 years for each bus was assumed which is consistent with current operations at GET. However, as all CNG vehicles must be off the road before 2040 and to avoid a single year with significantly more purchases, the expected retirement age was varied with a maximum value of 14 years. The resulting fleet composition includes a full FCEB fleet containing 84 standard buses.

Figure 9 and Figure 10 display GET's fixed route fleet composition and purchases by bus type each year, respectively.

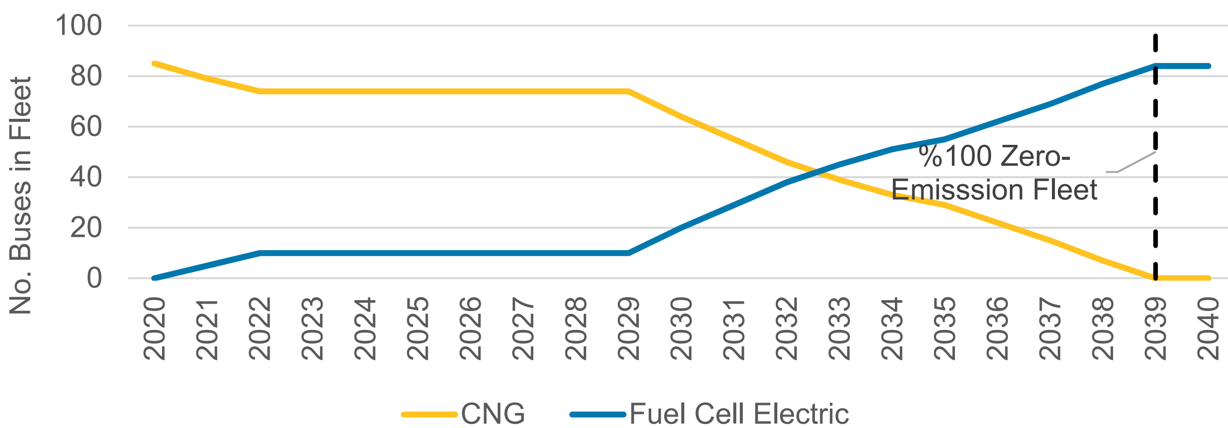


Figure 9: Fixed route fleet composition by fuel type from 2020 - 2040

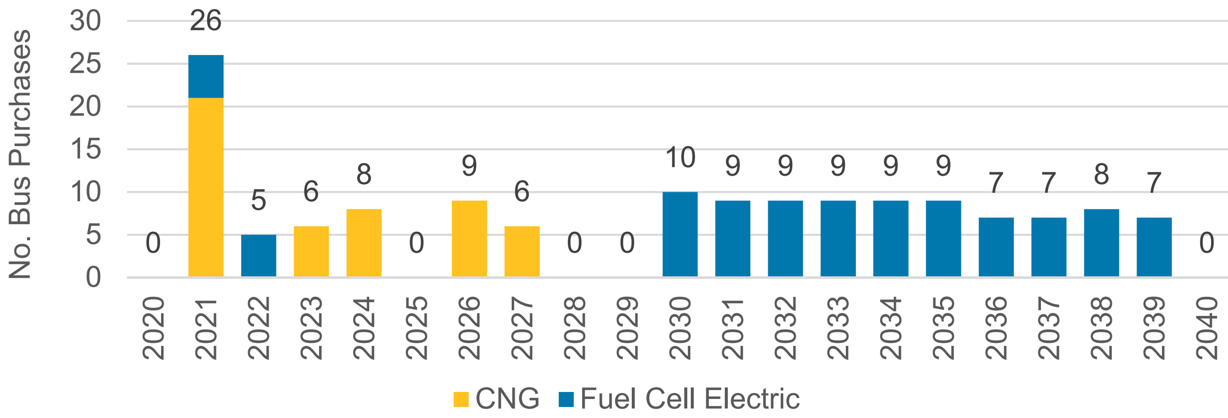


Figure 10: Fixed route future bus procurements by fuel type and year, from 2020 – 2040

GET plans on introducing 10 FCEBs prior to 2023 to gain experience with ZEB technology and to reduce capital costs associated with ZEB procurements in the years leading up to and following the potential site relocation in 2025. This will allow flexibility if the move is required and limit the scale and complexity of relocating equipment related to the hydrogen fueling infrastructure. The ZEB procurements required from 2023 to 2029 will be satisfied by the 10 FCEBs to be deployed before 2023 and the associated bonus credits.

The number of ZEB purchases per year following the 100% ZEB purchase mandate in 2029 was selected to maximize the lifetime of hydrogen fueling infrastructure and allow a gradual increase in required infrastructure upgrades.

Paratransit

GET's paratransit replacement plan introduces ZEBs in accordance with the ICT Regulation requirements for cutaway vehicles. A retirement age of 7 years for each cutaway vehicle was assumed, which is consistent with GET's current operations. To avoid a single year with significantly more purchases, the expected retirement age was occasionally altered to better distribute procurements across years; resulting in the fleet's retirement age to range with a maximum value of 7 years. GET's paratransit fleet composition and future bus procurements per year are displayed in Figure 11 and Figure 12, respectively. Like the fixed route fleet, ZEB procurements have been sequenced to avoid the relocation of electrical infrastructure assuming a move in 2025.

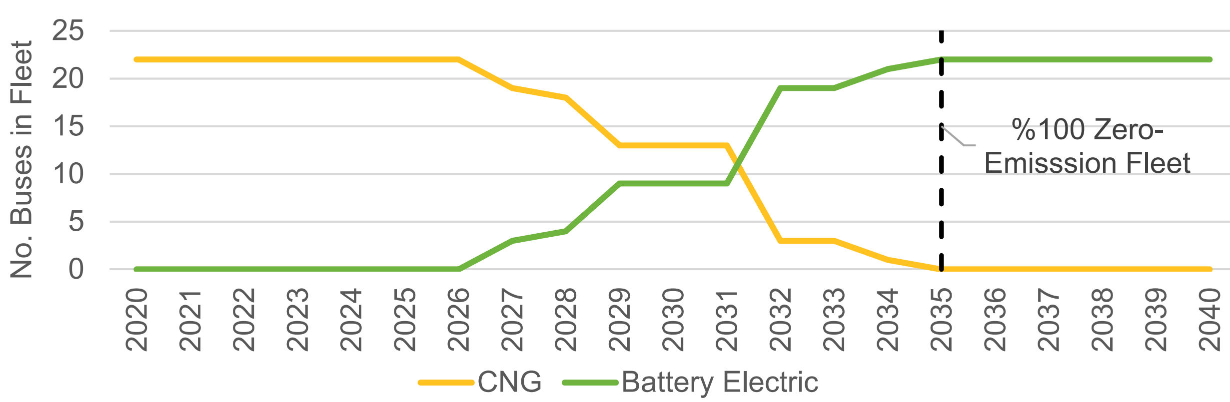


Figure 11: Paratransit fleet composition by fuel type from 2020 – 2040

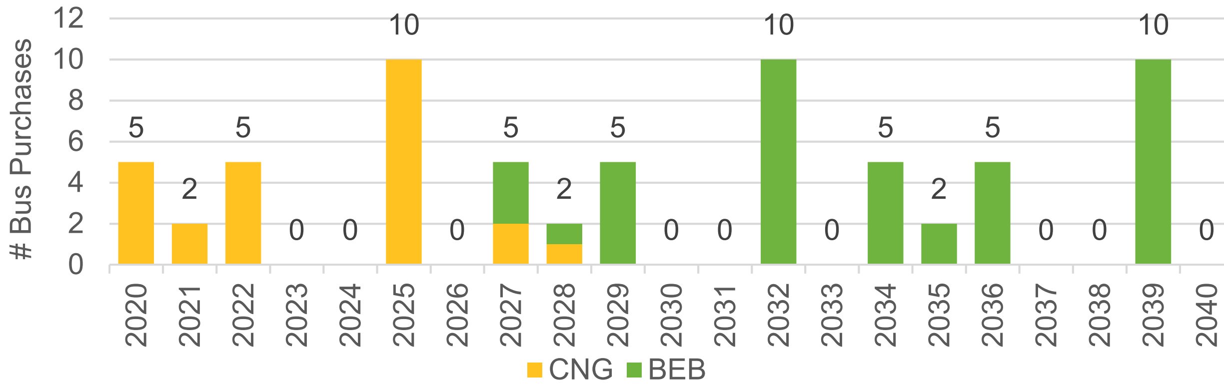


Figure 12: Paratransit future bus procurements by fuel type and year, from 2020 - 2040

All paratransit ZEB purchases are planned to be BEBs due to the current lack of fuel cell electric paratransit vehicles on the market. GET will continue to monitor market developments and may adjust this assumption as new information becomes available. The paratransit fleet will be completely transitioned to ZEBs by 2035.

ICT Regulation Compliance Table

To adhere to the ICT guidelines, GET's fleet transition plan uses bonus credits and ZEBs purchased before 2023 to meet its ZEB purchase obligations from 2023-2028. In 2021 and 2022, GET will add 10 FCEBs to the fleet, generating 10 bonus credits and 10 ZEBs that have not been used to meet ICT obligations. Between 2023 and 2028 these bonus credits and existing buses will be used to meet the ICT Regulation ZEB obligation instead of purchasing new buses. Starting in 2029, all new bus purchases will be ZEB, in accordance with the regulation.

Table 8: Annual ZEB obligation and use of ZEB bonus credits

Year	ZEB Obligation	Available ZEB Currency		Actual Required	Used ZEB Currency			Generated ZEB Currency	
		Bonus	Existing		Bonus	Existing	New	Bonus	Existing
2020	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	5	5
2022	0	5	5	0	0	0	0	5	5
2023	2	10	10	0	2	0	0	0	0
2024	2	8	10	0	2	0	0	0	0
2025	0	6	10	0	0	0	0	0	0
2026	5	6	10	0	5	0	0	0	0
2027	6	1	10	0	1	5	0	0	3
2028	1	0	8	0	0	1	0	0	1
2029	5	n/a	n/a	5	0	0	5	0	0
2030	10	n/a	n/a	10	0	0	10	0	0
2031	9	n/a	n/a	9	0	0	9	0	0

2032	19	n/a	n/a	19	0	0	19	0	0
2033	9	n/a	n/a	9	0	0	9	0	0
2034	14	n/a	n/a	14	0	0	14	0	0
2035	11	n/a	n/a	11	0	0	11	0	0
2036	12	n/a	n/a	12	0	0	12	0	0
2037	7	n/a	n/a	7	0	0	7	0	0
2038	8	n/a	n/a	8	0	0	8	0	0
2039	17	n/a	n/a	17	0	0	17	0	0
2040	0	n/a	n/a	0	0	0	0	0	0

E. Facilities & Infrastructure Modifications

GET Facility Infrastructure Upgrades

Figure 13 shows site overview of GET's facility. The green box shows the approximate area where hydrogen fueling infrastructure will be installed. This location was selected after performing a siting analysis based on NFPA 2, Hydrogen Technologies code and listed setback restrictions. Other areas inside GET's main yard to the east were analyzed and deemed too close in proximity to the buildings and parked cars and would potentially disrupt the flow of traffic in the depot. An analysis of the site has confirmed no buried utilities in the area across the paved road from the portables, therefore the hydrogen infrastructure can be safely sited as indicated. The key NFPA 2 restrictions can be met at this site, which are to maintain the proper setback distances from parked cars, building openings, buried utilities, and high voltage overhead lines.

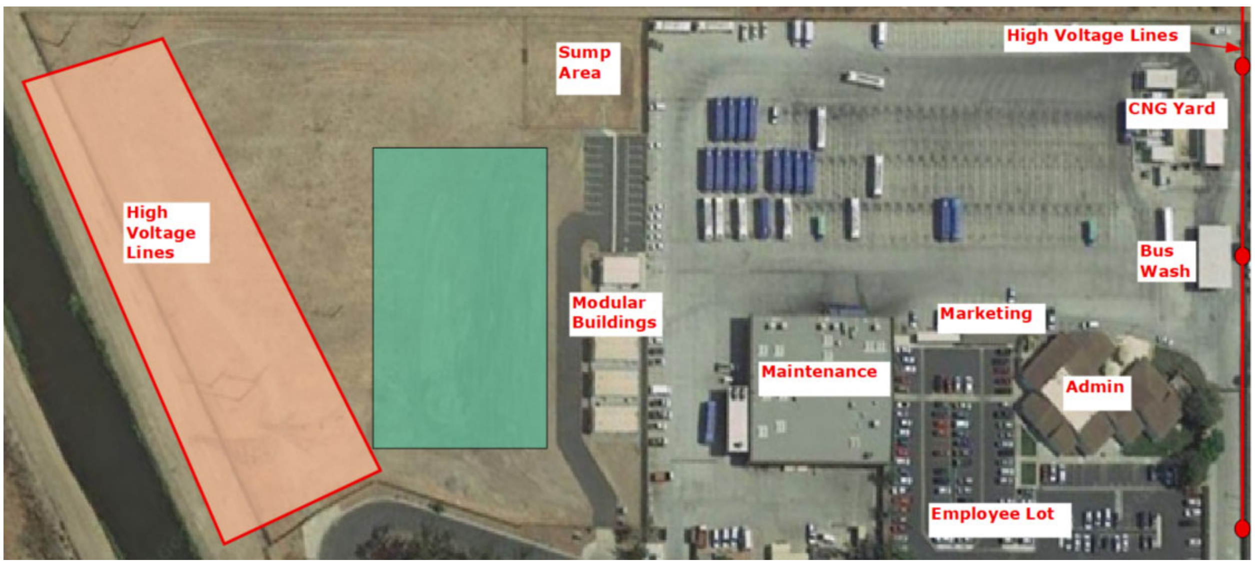


Figure 13: GET facility site overview

As mentioned in the Transition Cost Scenario Analysis, GET may relocate its facility in 2025. At this time, no site has been selected and funding for the moving costs and new facility construction has not been allocated, except for hydrogen fueling equipment which is listed as an optional expense. Since the relocation is uncertain, the infrastructure modifications have been split into two scenarios to account for both possibilities:

Scenario 1: GET selects a site and relocates in 2025

Scenario 2: GET remains at its current location indefinitely

The infrastructure installation and modifications will be divided into two phases. Phase I is the initial deployment between 2020 and 2024 and is common for both scenarios. Phase II spans the 2025-2040 timeframe, when the two scenarios diverge.

Phase I

GET has already placed an order for its first 5 FCEBs, estimated to be delivered in early 2021. Since the lead times for the purchasing, construction, and commissioning of a permanent hydrogen fueling station is greater than one year, GET will deploy a temporary hydrogen fueling solution in either scenario that will be used to fuel these buses until permanent fueling infrastructure can be constructed. GET is in discussions with vendors that can provide temporary fueling infrastructure, such as mobile gaseous hydrogen storage and fueling systems to support its 5 FCEB fleet during the transition period.

The initial construction of permanent fueling infrastructure will be designed to service 10 FCEBs and allow for an economical relocation in 2025. Since GET's facility is close to its available electrical capacity, electrical infrastructure upgrades may be required to service the additional loads from the hydrogen fueling station. GET is currently in discussions with its electrical utility, PG&E, to investigate the associated costs and available capacity at its substation.

Table 9 details how electrical demand scales with the capacity of permanent hydrogen fueling infrastructure, based on information from potential equipment vendors. From these estimates, Phase I deployment will require a capacity upgrade of 300 amps (480 VAC, 3 phase, 60 Hz) to support the fueling infrastructure at GET's current site.

Table 9: Permanent hydrogen fueling infrastructure electrical demand

FCEBs Supported	Electrical Draw (Amps)
10	300
30	400
50	500

GET has contracted a consultant to investigate the changes required to fully modify the existing maintenance facility so that it is compliant with FCEB repair garage safety codes and standards. It was found the costs to upgrade the entire facility would be approximately $1.1 million.

GET is undertaking a construction project to extend the maintenance facility and install several new maintenance bays. It will be much less costly to design this new section of the maintenance facility to be compliant with all hydrogen codes and standards than to upgrade the entire building. Therefore, GET will not upgrade the existing facility unless it is determined that GET will not need to relocate. The new extension to the building will be hydrogen compliant and will be large enough that all maintenance on the initial deployment of 10 buses can be completed in this portion of the maintenance facility. The existing portion of the facility will serve the CNG buses only. In both scenarios, only the maintenance building extension will be hydrogen compliant during Phase I.

Phase II

Phase II of the infrastructure deployment begins after the possible facility relocation in 2025. If GET relocates (Scenario 1) GET will move its CNG storage and dispenser equipment (CNG Yard in Figure 13) and hydrogen fueling infrastructure to the new location. As the fleet grows, the fueling infrastructure will be scaled up over time. At the new site, a new maintenance facility will be constructed that is capable of servicing the expanded fleet and fixed route CNG and FCEBs, and paratransit BEBs.

If GET does not relocate (Scenario 2) the fueling equipment will stay in place and will be scaled up over time. Once the FCEB fleet expands beyond 10 buses, the entire maintenance facility will be upgraded to meet hydrogen codes and standards.

Table 10 shows the stepwise deployment and scaling up of the permanent hydrogen fueling infrastructure for both Scenarios 1 and 2.

Table 10: Hydrogen storage and fueling infrastructure details

Estimated Upgrade Date	Major equipment to be Installed (estimate)	Upgraded Station 40' FCEB capacity
2020	• Temporary mobile hydrogen compression, storage, and dispensing station	5
2021	• Hydrogen liquid storage tank (leased) • Compressors • 2 x hydrogen pumps • 6 x high pressure gas storage cylinders • Vaporizer • Fueling system • 1 x dispenser	10
2029	• 6 x high pressure storage cylinders • Fuel pre-cooling system • 1 x dispenser	25
2031	• 6 x high pressure storage cylinders • 1 x dispenser	50
2035	• Additional liquid storage tank (leased) • Compressors • 2 x hydrogen pumps • Vaporizer • 9 x high pressure storage cylinders • 1 x dispenser	84

BEB charging infrastructure will be added to serve the paratransit fleet starting in 2027. If GET does not relocate or if there is limiting capacity at the new site, upgrades will be required to increase the electrical capacity to provide power for the chargers. Table 11 details the electrical charging infrastructure equipment required to support the paratransit BEBs in both Scenarios 1 and 2.

Table 11: Electrical charging infrastructure details

Estimated Upgrade Date	Major equipment to be Installed (estimate)
2027	• Electrical distribution infrastructure (e.g., switches, cables, meters, panels) • 4 x electric charging dispensers
2029	• 5 x electric charging dispensers
2032	• 10 x electric charging dispensers
2034	• 3 x electric charging dispensers

Table 12 details the facilities modifications and construction timeline for both scenarios.

Table 12: Facilities information and construction timeline

Facility Name	Address	Main Function(s)	Type(s) of Infrastructure	Service Capacity	Needs Upgrade?	Construction Timeline
GET Depot	1830 Golden State Ave, Bakersfield, CA	Temporary hydrogen fueling for FCEBs	Mobile Gaseous hydrogen storage and fueling infrastructure	150 kg/day H_2 fueling capacity for 5 FCEBs	New Construction	2021
		Electrical capacity upgrade to service temporary and permanent hydrogen fueling infrastructure	Behind the meter infrastructure from PG&E others (e.g., switch gear, transformer)	300-500 Amps of 480 VAC, 3 phase, 60 Hz power (estimate)	New Construction	2021
		FCEB maintenance and repair	Hydrogen compliant maintenance bays	10 FCEBs	New construction	2021
		Permanent hydrogen fueling for FCEBs	Liquid hydrogen storage and fueling infrastructure	300 kg/day H_2 fueling capacity for 10 FCEBs	New Construction	2021
	1830 Golden State Ave, Bakersfield, CA or New Facility	Bus maintenance and repair*	New maintenance facility capable of repairing FCEBs and BEBs	Sized to service full transitioned fleet of 84 FCEBs and 22 paratransit BEBs	New Construction	2025
		Bus maintenance and repair**	Upgrade current maintenance facility capable of repairing FCEBs and BEBs	Sized to service full transitioned fleet of 84 FCEBs and 22 paratransit BEBs	Upgrade	2030
		Electrical capacity upgrade to service BEB chargers**	PG&E behind the meter supply infrastructure and others (e.g., switch gear, transformer)	0.5 MW	New Construction	2027
		Overnight depot charging of paratransit BEBs	BEB charging infrastructure	Charging of 22 paratransit BEB vehicles	New Construction	2027-2034
		Upgrade of Hydrogen Fueling infrastructure to increase capacity for growing FCEB fleet	Liquid hydrogen storage and fueling infrastructure	750 kg/day H_2 fueling capacity for 25 FCEBs	Upgrade	2029
		Upgrade of Hydrogen Fueling infrastructure to increase capacity for growing FCEB fleet	Liquid hydrogen storage and fueling infrastructure	1500 kg/day H_2 fueling capacity for 50 FCEBs	Upgrade	2031
		Upgrade of Hydrogen Fueling infrastructure to increase capacity for growing FCEB fleet	Liquid hydrogen storage and fueling infrastructure	2520 kg/day H_2 fueling capacity for 84 FCEBs	Upgrade	2035

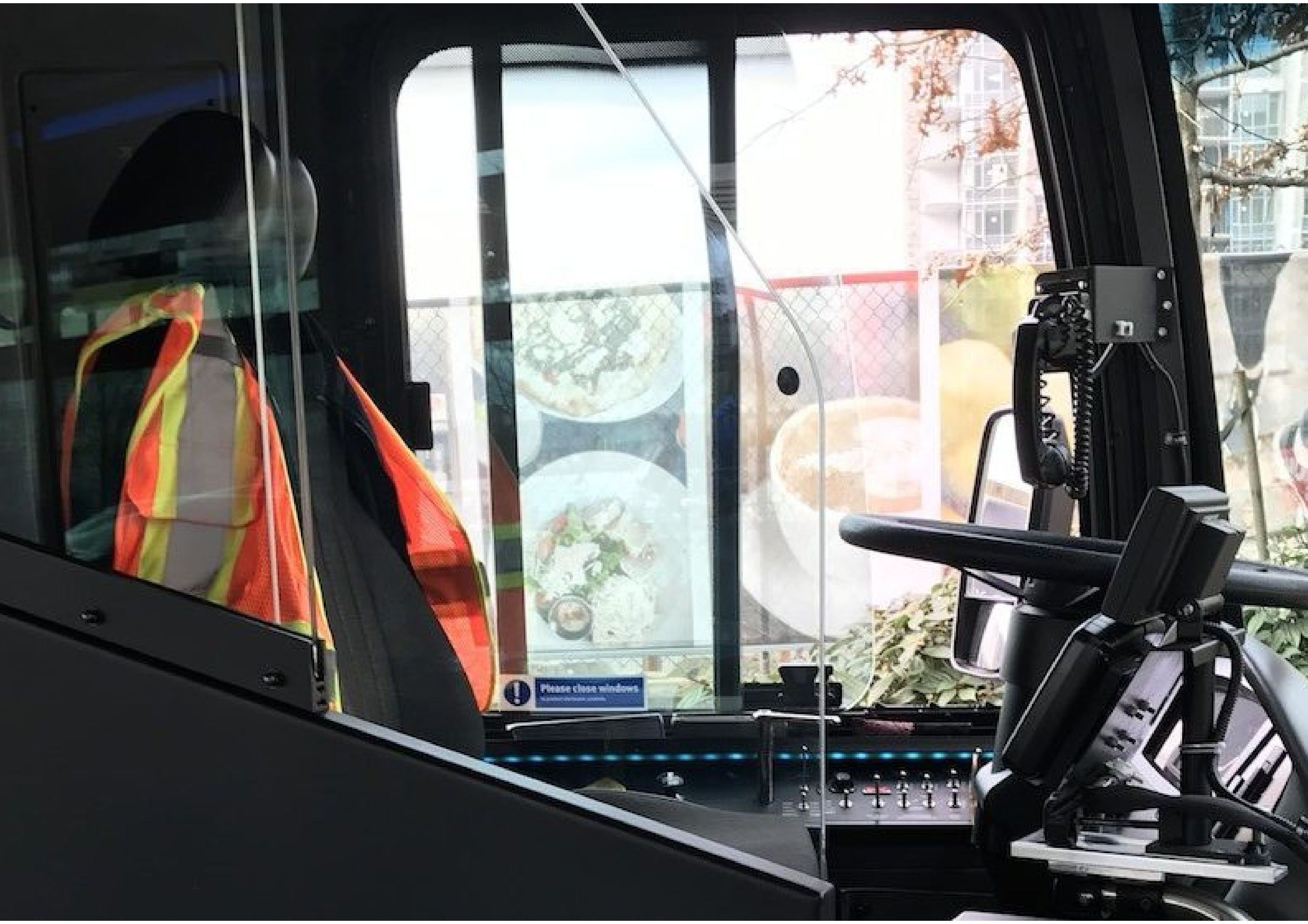
*Occurs only in Scenario 1 (site is relocated)
**Occurs only in Scenario 2 (site is not relocated)

Facility Propulsion Systems

Kern county is not designated as a NOx exempt area based on CARB, Table 13 identifies the type of buses which will operate out of Golden Empire Transit's locations.

Table 13: NOx-exempt area and electric utilities' territories

Division's Name (Same as in Table 5)	Type(s) of Bus Propulsion System	Located in NOx-Exempt Area? (Yes/No)
Golden Empire Transit Depot	CNG, fuel cell, battery electric	No
Relocation Site (if applicable)	CNG, fuel cell, battery electric	No



F. Providing Service in Disadvantaged Communities

Figure 14 shows GET's routes labelled in various colours. The red overlay identifies disadvantaged communities as defined by Cal Enviroscreen 3.0. All of GET's routes service disadvantaged communities and will continue to for the foreseeable future.

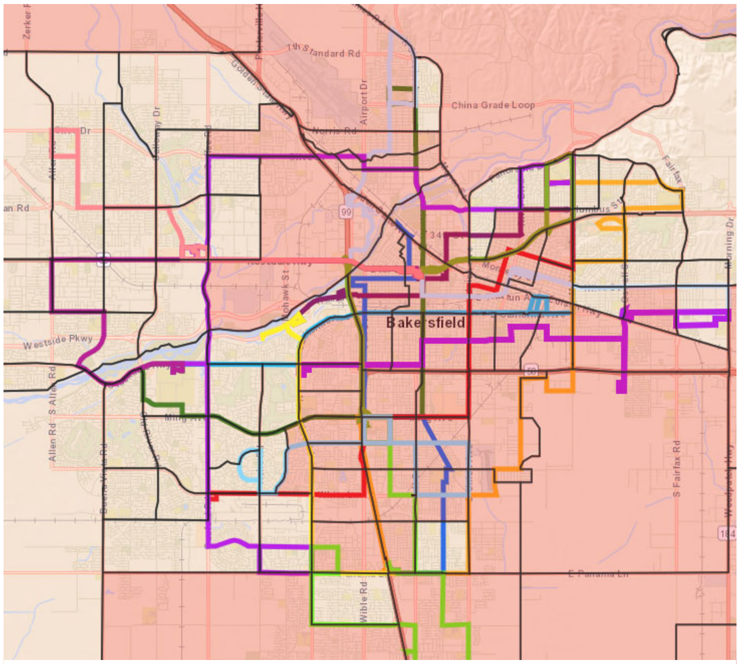


Figure 14: Cal Enviroscreen 3.0 disadvantaged communities map

Bakersfield is in Kern County, California, and does not meet the Environmental Protection Agency's air quality standards and is designated as an ozone non-attainment area. In 2019, the American Lung Association rated Bakersfield as the 3rd worst city in the US for ozone pollution, the second worst in the US for year-round particle pollution and the worst city in the US for short term particle pollution.

Disadvantaged communities are disproportionally burdened by multiple sources of pollution and typically have population characteristics that make them more sensitive to pollution than the wider population. Improving local air quality by reducing critical emissions of criteria pollutants NOx, VOC, and CO that contribute to the production of ozone. These reductions directly support state and local government efforts to achieve the NAAQS ozone "attainment" classification. In addition, zero-emission vehicles do not emit particulate matter (PM2.5) and contribute significant reductions in GHG emissions, further contributing to improved local air quality.

G. Workforce Training

GET will receive training provided by vehicle OEMs, technology suppliers and infrastructure providers as equipment is deployed onsite. Additional training will be provided by other transit agencies and / or outside programs, such as the West Coast Center of Excellence in Zero-Emission Technology hosted by SunLine Transit Agency.

GET will utilize a “train the trainer” approach by which key operations and maintenance personnel, such as lead technicians and supervisors, will take part in the OEM and vendor training programs to bring the technical expertise and knowledge in-house.

New Flyer has been selected to supply the first FCEBs to be deployed at GET and will provide safety and hands-on maintenance training for 10-12 of its lead maintenance personnel. After participating in and completing the program, the technicians will capture the learnings and create an in-house training program to train the rest of GET’s operations and maintenance staff on the specific knowledge and skills required for each role.

Fuel Cell Electric Bus Training:

Training will be provided by the selected OEM (e.g., New Flyer, ElDorado) in the following areas:

1. General hydrogen safety awareness training for onsite staff
2. Bus driver and operations staff training
3. FCEB maintenance and repair training
4. General bus overview introduction training

Three additional training courses will be provided by the fuel cell manufacturer (Ballard) regarding maintenance and troubleshooting of the fuel cell system.

Permanent Hydrogen Fueling Infrastructure Training

Training will be provided by the selected equipment vendor (e.g., Air Liquide, Air Products) in the following areas:

1. General hydrogen safety awareness training for onsite staff
2. Operator specific training on safe fueling procedures, using the gaseous and liquid hydrogen equipment
3. Maintenance and troubleshooting training on equipment
4. Emergency first responder training for fire department representatives as well as GET onsite first responder staff

Paratransit Battery Electric Bus Training

Training will be provided by the selected OEM (e.g., Proterra, New Flyer, BYD) in the following areas:

1. General bus overview introduction training
2. High voltage safety training
3. Bus maintenance and repair training

4. Bus driver and operations staff training

BEB Charging Infrastructure Training

Training will be provided by the selected equipment vendor (e.g., BYD, Proterra) in the following areas:

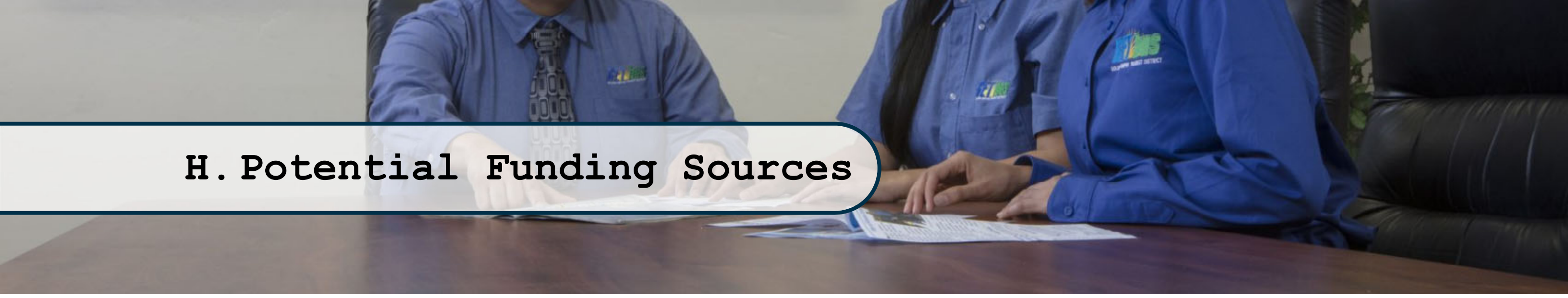
1. Charging infrastructure maintenance training
2. Emergency first responder training for Fresno FD representatives as well as GET onsite first responder staff

Table 14 shows the detailed workforce training plan. The information is based on general training outlines provided by OEMs, and do not reflect a mandatory curriculum. GET has the option to structure its staff training fully around the OEM training programs, or a combination of OEM training and other coursework offered through organizations such as SunLine.

Table 14: Workforce training schedule

Year	Training Program/Class	Purpose of Training	Name of Provider	Trainees' Positions	Training Hours	Training Frequency	Estimated Costs/Class
FCEB Training Plan							
2021	FCEB Operator Training	Operator orientation	FCEB OEM	Operator trainers, supervisors, or bus operators	8	1	TBD
	FCEB Maintenance Orientation	Routine servicing and maintenance procedures, hands-on demonstrations on topics such as emergency procedures and identifying service points	FCEB OEM	Bus maintenance technicians	8	1	TBD
	FCEB Propulsion & ESS	Familiarization, safety, and troubleshooting of energy storage and propulsion systems	FCEB OEM	Bus maintenance technicians	40	1	TBD
2021	Fire Suppression/Gas Detection	Familiarization, operation, maintenance of safety systems	FCEB OEM	Bus maintenance technicians	8	1	TBD
	Fuel Cell Stack Training (Standard)	Standard fuel cell stack maintenance procedures and protocols	Fuel Cell Manufacturer	Bus maintenance technicians	24	1	TBD
	Fuel Cell Stack Training (Advanced)	Advanced fuel cell stack maintenance procedures and protocols	Fuel Cell Manufacturer	Bus maintenance technicians	16	1	TBD
Hydrogen Infrastructure Training Plan							
2021	General Personnel Training	Overview training	Hydrogen Fueling Equipment OEM	Maintenance technicians or other yard personnel who need to be trained on material hazards and actions required by emergency response plan	TBD	1	TBD
	Operations Personnel Training	Training on handling, storing, and using the gaseous H_2 and liquid H_2 equipment (physical and health hazard training, dispensing equipment operation, liquid H_2 and gaseous H_2 storage safety training, safe transportation training	Hydrogen Fueling Equipment OEM	Operators, supervisors, equipment maintenance technicians	TBD	1	TBD
	Emergency First Responder Training	First responder training on hydrogen fueling infrastructure	Hydrogen Fueling Equipment OEM	First responder representatives	TBD	1	TBD
BEB Training Plan							

Year	Training Program/Class	Purpose of Training	Name of Provider	Trainees' Positions	Training Hours	Training Frequency	Estimated Costs/Class
2025	Operator Training	Bus functions training	BEB OEM	Operator trainers, supervisors, or bus operators	TBD	1	TBD
	Structural Composites Training	Hands-on training for structural composites repairs on buses	BEB OEM	Maintenance technicians	TBD	1	TBD
	Bus Maintenance Training	Training of bus maintenance technicians on routine servicing	BEB OEM	Bus maintenance technicians	TBD	1	TBD
Electric Charging Infrastructure Training Plan							
2025	Charger Maintenance Training	Training of charger infrastructure maintenance	Electric Charger Vendor	Charger Infrastructure maintenance technicians	TBD	1	TBD
	Emergency First Responder Training	First responder training on electrical buses and infrastructure	Electric Charger Vendor	Fresno first responder representatives	TBD	1	TBD



H. Potential Funding Sources

Significant capital expenditure will be required to successfully transition GET's fleet to zero-emission. Figure 15 shows the estimated annual capital expenditure required for the procurement of buses and accompanying ZEB charging / fueling infrastructure.

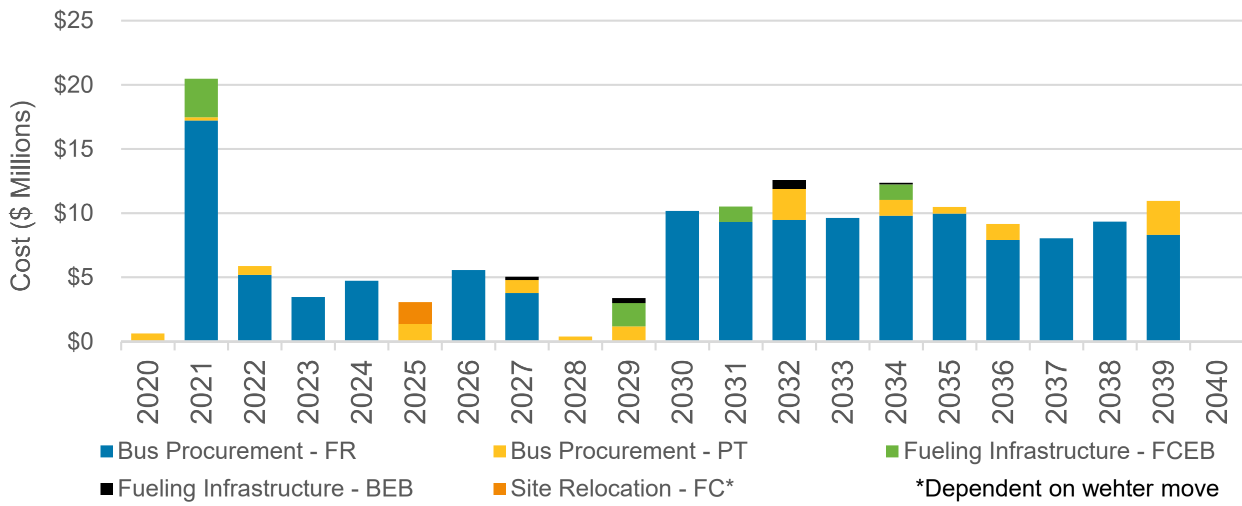


Figure 15: Estimated capital expenditure 2020-2040

The total capital expenditure for all bus purchases and required fueling / charging infrastructure improvements is estimated to be approximately $156 million between 2020 and 2040. This includes the purchase of both CNG buses and ZEBs to replace existing buses as they are retired. To achieve this level of funding, capital must be combined from multiple sources including formula funds and special grant funding.

The formula funds will primarily come from the Federal Transit Administration (FTA) through the Urbanized Area Formula Grants (5307) and the Bus and Bus Facilities Program (5339). The funding available from each of these sources was estimated based on the level of funding previously received through each program and the percent allocation of these funding sources historically applied to bus purchases. The annual funding was increased at a rate of 2.5%, which is consistent with the historical year over year change.

Table 15 shows the estimated funding available from the 5307 and 5339 grants in the next fiscal year (FY2021) and throughout the entire project (2020-2040).

Table 15: Summary of estimated available formula funding

Fund	FY2021 Funding	Total Funding 2020-2040
5307	$4,310,272	$117,167,313
5339	$588,100	$15,986,478
Total	**$4,898,372**	**$133,153,791**

GET will require an additional $23 million to pay for the required capital investment to transition the bus fleet. It is anticipated that this funding will come primarily through special grant funding from a variety of sources, including the California Department of Transportation (Caltrans) and California State Transportation Agency (CalSTA). Several programs are currently operating to provide funding, but it is difficult to predict what will be available over the 20-year span of this plan.

Table 16 shows some of the potential special grant funding programs that GET may apply for.

Table 16: Potential funding sources summary

Type	Name	Purpose	Offering	Funds Available
Competitive	FTA 5339 (b) Bus & Bus Facilities	Bus procurement and related facilities	80% of capital costs	$457 million (FY2020)
	FTA 5339 (c) Low or No Emission Vehicle	ZEB procurement and fueling / charging infrastructure	85-90% of capital costs	$130 million (FY2020)
	Caltrans Low Carbon Transit Operations Program	Reduce transit agency GHG emissions	Equipment acquisition, fueling, maintenance, and other costs	$146 million (awarded FY2020)
	CalSTA Transit and Intercity Rail Capital Program	Reduce transit agency GHG emissions	Up to 100% of capital costs	$500 million (awarded FY2020)
Voucher	VW Mitigation	ZEB procurement	$400,000/FCEB; $180,000/BEB	$130 million (until exhausted)
	HVIP	ZEB procurement	$300,000/FCEB; $175,000/BEB	$142 million (FY2019 - currently exhausted)

GET would also benefit from the passing of the Investing in a New Vision for the Environment and Surface Transportation in America Act that was approved by the United States House Transportation and Infrastructure Committee on June 18, 2020. This bill would significantly increase available federal funding for zero-emission buses and infrastructure to $1.7 billion for fiscal year 2022 through 2025.

I. Start-Up and Scale-Up Challenges

Considerable funding will be required to complete the ZEB transition, which presents a significant challenge to the agency. ZEBs are more expensive to purchase than conventional CNG vehicles and the cost of hydrogen is currently greater than CNG. The increased capital and operating budgets will necessitate financial support from the federal, state, and local governments.

Increased capital expenditures will be required annually due to the incremental cost of ZEBs compared to CNG vehicles and the need to install hydrogen refueling and BEB charging equipment. These costs are likely to reduce relative to incumbent technologies through economies of scale, so near- to mid-term funding is particularly important. The cost to the agency could also be reduced through a state-led initiative to purchase ZEBs in bulk on behalf of multiple agencies. This would decrease the per-vehicle cost since the price is tied to procurement volumes.

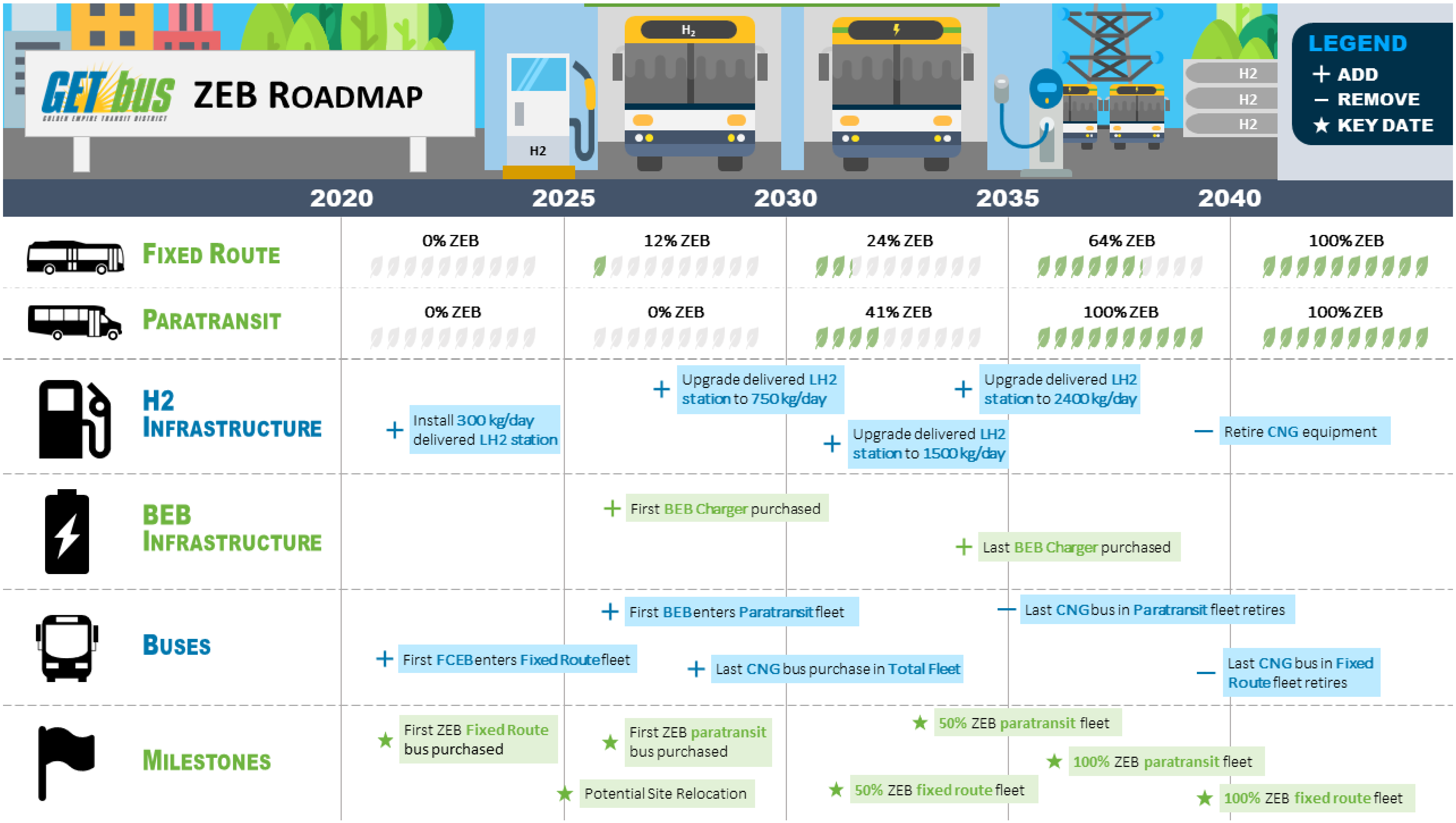
To ensure successful uptake of ZEBs, GET will need to provide quality workforce training to staff. Maintenance and operations courses will be required relating to both the ZEBs and accompanying infrastructure. The efficiency of ZEBs is strongly linked to driver behavior, which requires a shift from current CNG driving practices so that the benefits of regenerative braking are realized. The range of BEBs can be reduced by as much as 10-20% if the vehicles are driven ineffectively. In addition to training, it will be critical to solicit feedback on the ZEBs from the entire labor force through outreach and education activities.

While the ZEB Rollout Plan will serve as a useful guide for the ZEB transition, there are many unknowns that will impact implementation. ZEBs have not been on the road in great numbers for long enough to fully understand and predict performance, reliability and robustness, and the technology is improving all the time. GET will continuously revaluate ZEBs and fueling infrastructure purchases based on product availability and performance data. Access to information demonstrating how ZEBs perform under a range of conditions including high heat conditions and near end-of-life operation will help guide future purchasing decisions. GET will track and evaluate performance of their own vehicles, but it would be useful to share data between agencies so that decisions can be informed by as much data as possible.

A major challenge for the GET ZEB Rollout Plan is the uncertainty as to whether their facility must be relocated. The plan was designed to allow for either possibility, but the uncertainty makes long-term planning more difficult. If a move is required, it is unclear where the new location will be, so it is not possible to plan to specific constraints like the availability of electrical infrastructure or space. GET will revaluate this plan as it becomes clear whether a move will be required.

It is critical that CARB support funding initiatives to reduce the financial burden to the agencies as fleets transition to zero-emission. Funding will be required to support capital expenditure for vehicles, fueling / charging infrastructure, maintenance facility upgrades, and workforce training. Funding should also be made available to study performance of ZEBs under a range of conditions and the results should be widely available. CARB is well positioned to facilitate the sharing of information between agencies about ZEB performance through educational outreach.

Appendix A. GET ZEB Roadmap



Appendix B. Board Resolution

RESOLUTION NO. 2020-13

IN THE MATTER OF:

ZERO EMISSION BUSES ROLLOUT PLAN (ZEB)

WHEREAS, The California Air Resources Board (CARB) requires that all public transit organizations become a zero-emission transit system by 2040, and

WHEREAS, The Zero Emission Buses Rollout Plan regulation applies to any provider of public transportation in the state of California, and

WHEREAS, Golden Empire Transit District has now completed their Zero Emission Buses Rollout Plan and subsequent updates must be signed by the Executive Officer commencing March 31, 2021, and continuing every year thereafter through March 31, 2050.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Golden Empire Transit District hereby approves the GET Zero Emission Buses Rollout Plan.

NOW, THEREFORE, BE IT FURTHER RESOLVED that insofar as the provisions of any Ordinance, Resolution, document or previous action of the Board and/or the Chief Executive Officer, prior to the date of this Resolution, are inconsistent with the provisions of this Resolution or any policy adopted by this Resolution, this Resolution and the Board Policies adopted herein shall control.

NOW THEREFORE, BE IT FURTHER RESOLVED that the Chief Executive Officer or her designee be authorized to execute all required documents of the Zero Emissions Buses Rollout Plan and any Amendments thereto.

All the foregoing, being on motion of Director Leasa Engel seconded by Director Ruben Pasqual and authorized by the following roll call vote:

1830 Golden State Avenue Bakersfield, California 93301-1012 (661) 324-9874 Fax (661) 869-6394

AYES: Baldwin, Bello, Engel, Parra, Pasqual
NOES: NONE
ABSENT: NONE
ABSTAIN: NONE

CERTIFICATION

The undersigned duly qualified Secretary of the Board of Directors of the Golden Empire Transit District certifies that the foregoing is a true and correct copy of the resolution adopted at a legally convened meeting of the Board of Directors of the Golden Empire Transit District held on the 18th day of August 2020.

Karen H. King
Secretary of the Board of Directors

1830 Golden State Avenue Bakersfield, California 93301-1012 (661) 324-9874 Fax (661) 869-6394