Zero-Emission Bus Program Update

Background

- December 2018, the California Air Resources Board passed the Innovative Clean Transit (ICT) rule
  - Requires transitioning to zero-emission bus (ZEB) fleet by 2040
  - Purchasing requirements begin in 2023
- June 2020, the Orange County Transportation Authority (OCTA) Board of Directors (Board) approved the OCTA ZEB Rollout Plan
  - Includes a mix of zero-emission technologies
- February 2020, OCTA initiated the Fuel-Cell Electric Bus (FCEB) Pilot
  - Ten 40-foot FCEBs, a hydrogen fueling station, maintenance shop upgrades
  - Grant Funded $13.2M - California Air Resources Board and South Coast Air Quality Management District
- July 2022, OCTA initiated the Battery-Electric Bus (BEB) Pilot
  - Started with two BEBs, eight more arrived in December 2022
  - Grant Funded $10.3M - California Transportation Commission Solutions for Congested Corridors Program under SB 1 (Chapter 5, Statutes of 2017) and the Low Carbon Transit Operations Program (LCTOP)
- June 2024, Battery Electric Paratransit Bus Pilot
  - Board approved the purchase of ten battery-electric paratransit buses and infrastructure.
  - Grant Funded $2.5M - FTA's Buses and Bus Facilities, and Low and No Emission Vehicle programs
- November 2024
  - OCTA Board approved the purchase of 40 additional FCEB and ten additional BEB
  - Grant funded through the following sources: Transit and Intercity Rail Capital Program, (LCTOP), Congestion Mitigation and Air Quality, Conservation Reserve Program, and SB 125 Transit Program (Chapter 54, Statutes of 2023)

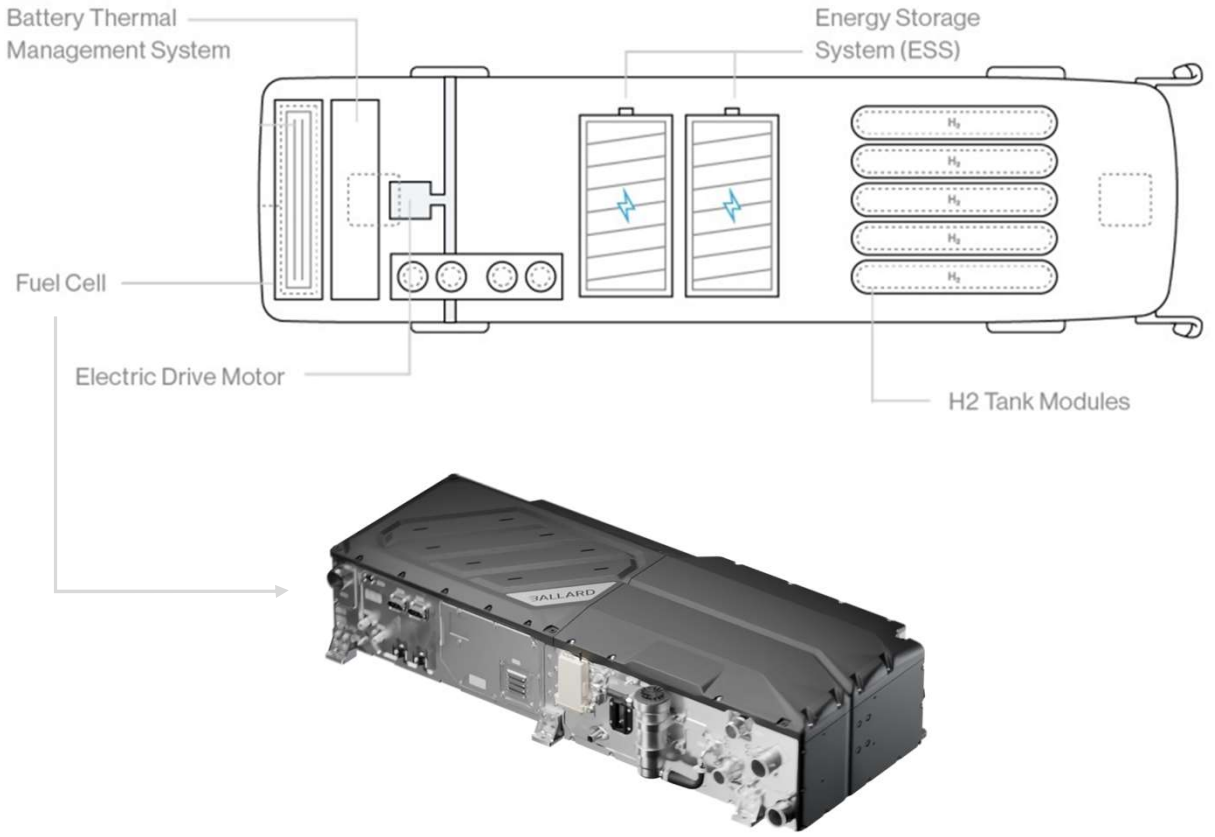
ZEB Pilot Buses

Vehicle Information	CNG Bus	FCEB	BEB
Number of Buses	10	10	10
Manufacturer/Model	New Flyer Xcelsior	New Flyer Xcelsior	New Flyer Xcelsior
Model Year	2016	2018	2020
Deployment Date	Aug-18	Feb-20	Dec-22
Bus Purchase Price	$580,000	$1.3M	$1.1M
Length	40 foot	40 foot	40 foot
Curb Weight	30,000 pounds	33,560 pounds	33,500 pounds
Propulsion System	CNG Engine 280 hp (209 kW)	Electric Motor 210 kW	Electric Motor 210 kW
	Transmission	Fuel Cell 85 kW	
Energy Storage	Six Composite Fuel Cylinders	Five Composite Fuel Cylinders	
		Lithium-ion Batteries 100 kW	Lithium-ion Batteries 440kW
Total Operating Range	400 miles	300 miles	200 miles
Usable Operating Range	350 miles	250 miles	150 miles

*FCEB – Fuel Cell Electric Buses
*BEB – Battery Electric Buses
*CNG – Compressed Natural Gas

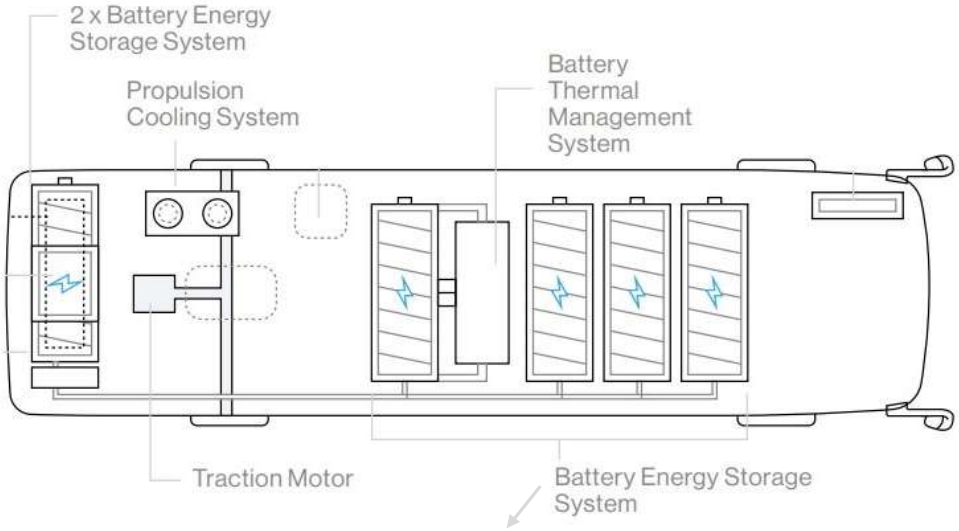
Fuel-Cell Electric Bus

- Deployed in February 2020
- Same standard equipment as the OCTA CNG bus
- Fuel cell acts as an onboard battery charger
- Operated 1,448,366 miles
- Able to operate on 80% of existing OCTA routes
- Refuel in six to ten minutes, similar to CNG
- Usable operating range 250 miles
- Fuel-Cell Performance Degrading
  - Six-year warranty
  - Overhauls in progress



Battery-Electric Bus

- Deployed in December 2022
- Same standard equipment as the OCTA CNG bus
- 100% battery electric
- Operated 294,025 miles
- Able to operate on 20% of existing OCTA routes
- Recharge in four hours
- Usable operating range 150 miles
- Battery Performance
  - Six-year warranty
  - Monitoring degradation



Key Performance Indicators

Bus Availability

- Percentage of days the buses are available compared to the total number of days that the buses are planned for revenue service

Miles Between Road Calls

- A road call is defined as a revenue vehicle mechanical or system failure that causes the bus to be replaced in route or causes a significant delay in the bus schedule

Fuel Economy

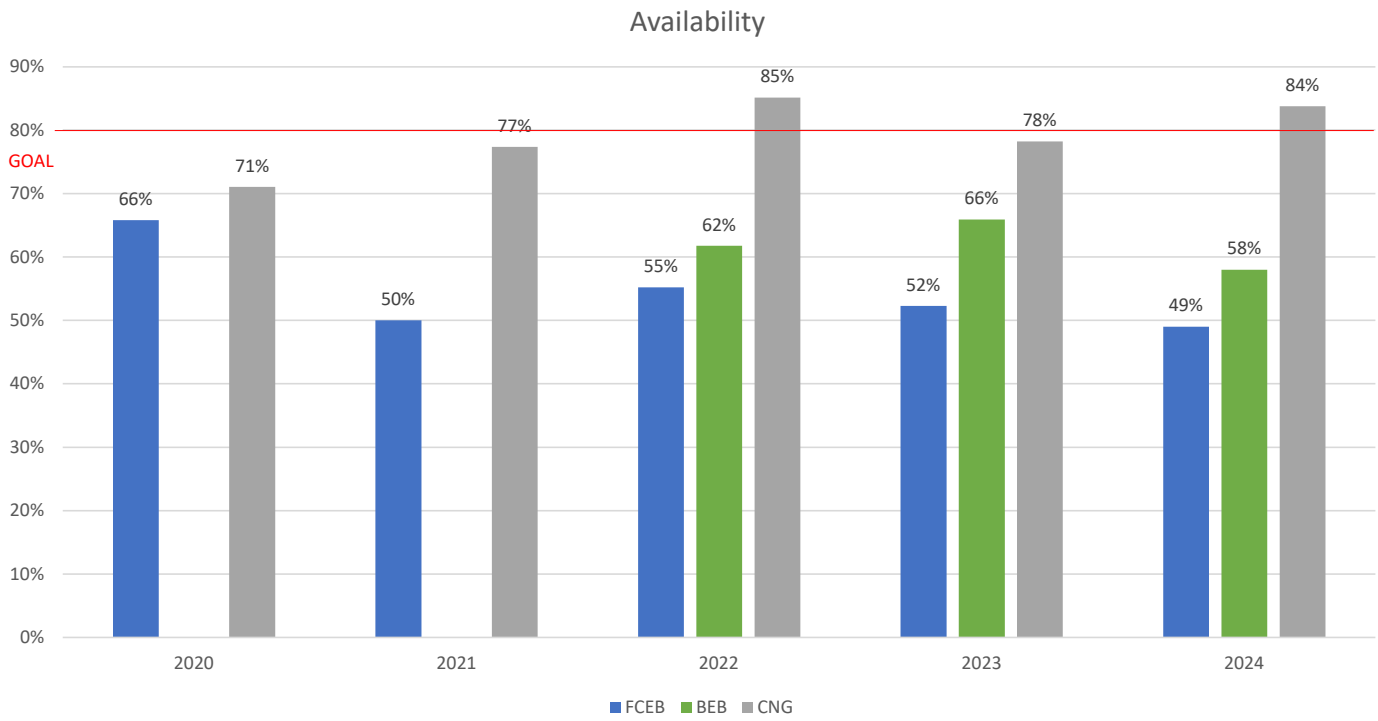
- Fuel economy is a measurement of how efficiently the fuel is being used by the propulsion system

Cost Per Mile

- OCTA calculates total cost per mile (CPM) for each technology by tracking parts and labor cost and fuel cost
- CPM is the lowest common denominator between the three technologies

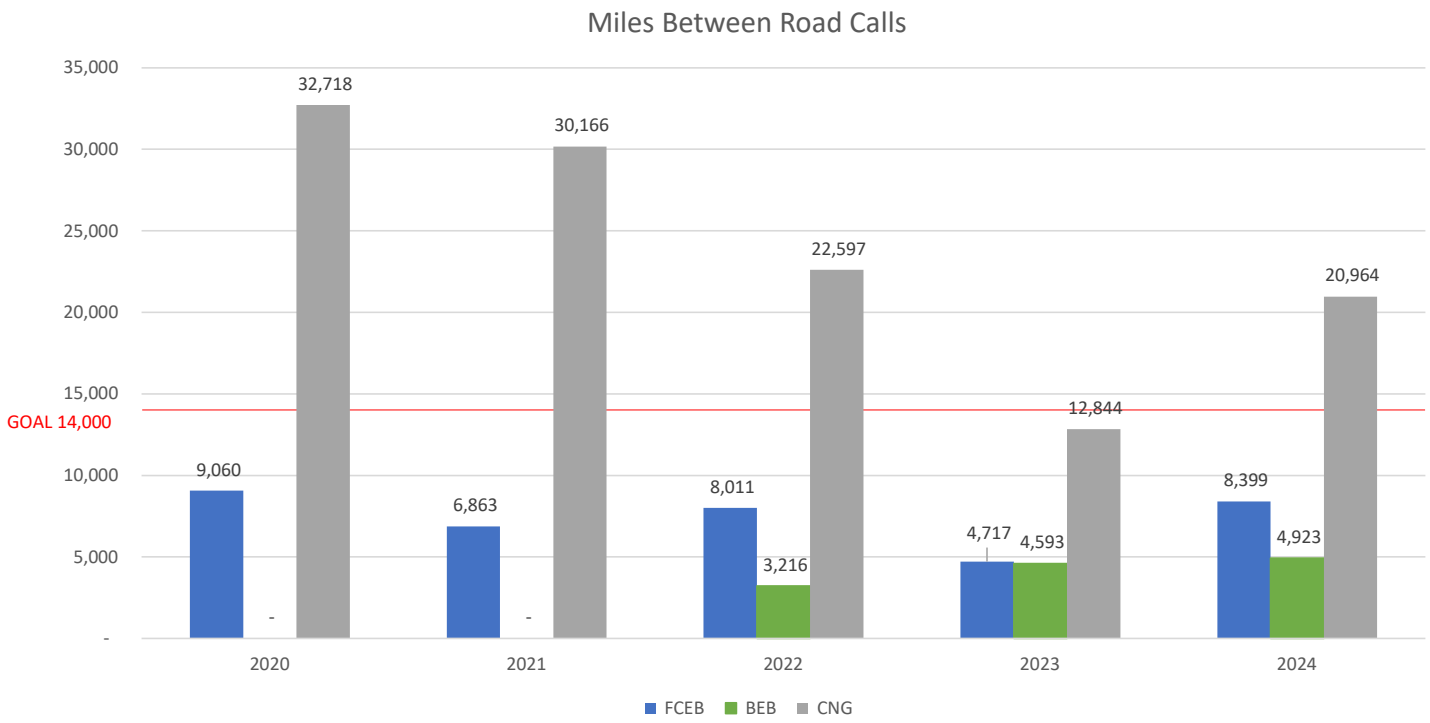
Bus Availability

- FCEB
  - Warranty repairs
  - Supply chain delays
- BEB
  - Warranty repairs



Miles Between Road Calls

- FCEB
  - Improving
  - Battery failures
  - Fuel-cell degradation
- BEB
  - Improving
  - Battery failures
  - Warranty repairs



Fuel Economy

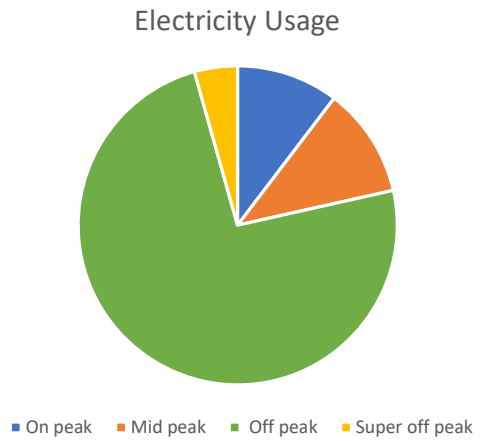
Measurement	FCEB	BEB	CNG
Miles per diesel gallon equivalent	7.57	18.14	3.19

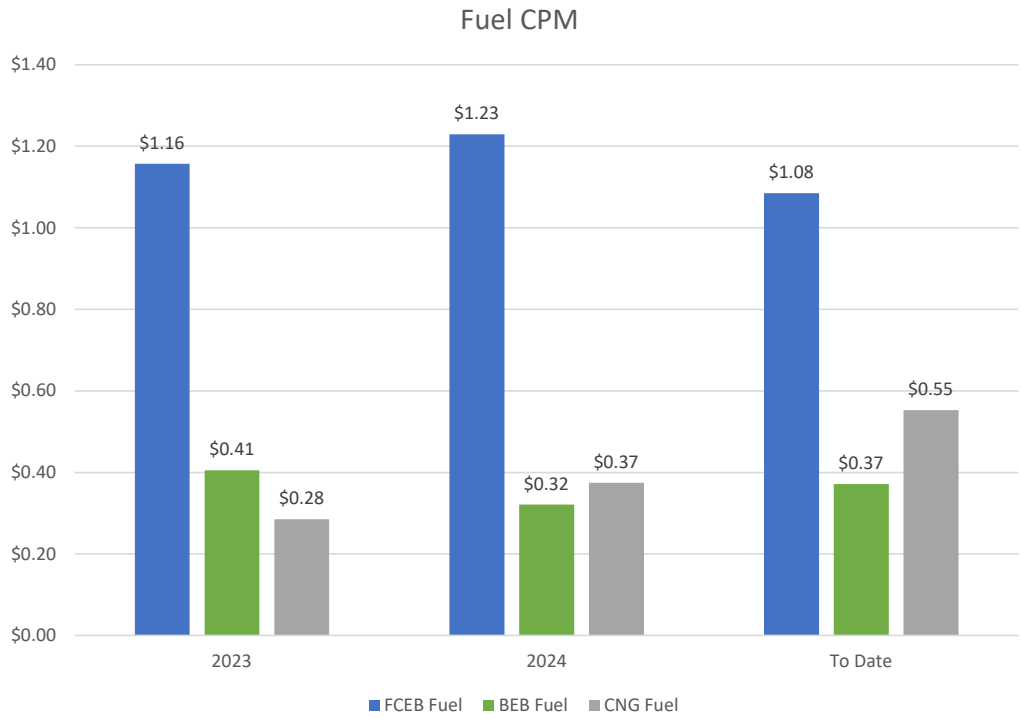
Fuel cost per unit	FCEB	BEB	CNG
Per kg, kW, Therm, respectively	$9.44	$0.30	$1.06

Fuel cost per mile	FCEB	BEB	CNG
2024	$1.23	$0.32	$0.37

Cost per Mile - Fuel

- FCEB fuel cost increased due to O&M agreement
- CNG fuel cost increased due to higher renewable natural gas and electricity prices
- BEB electricity cost decreased due to energy management tools

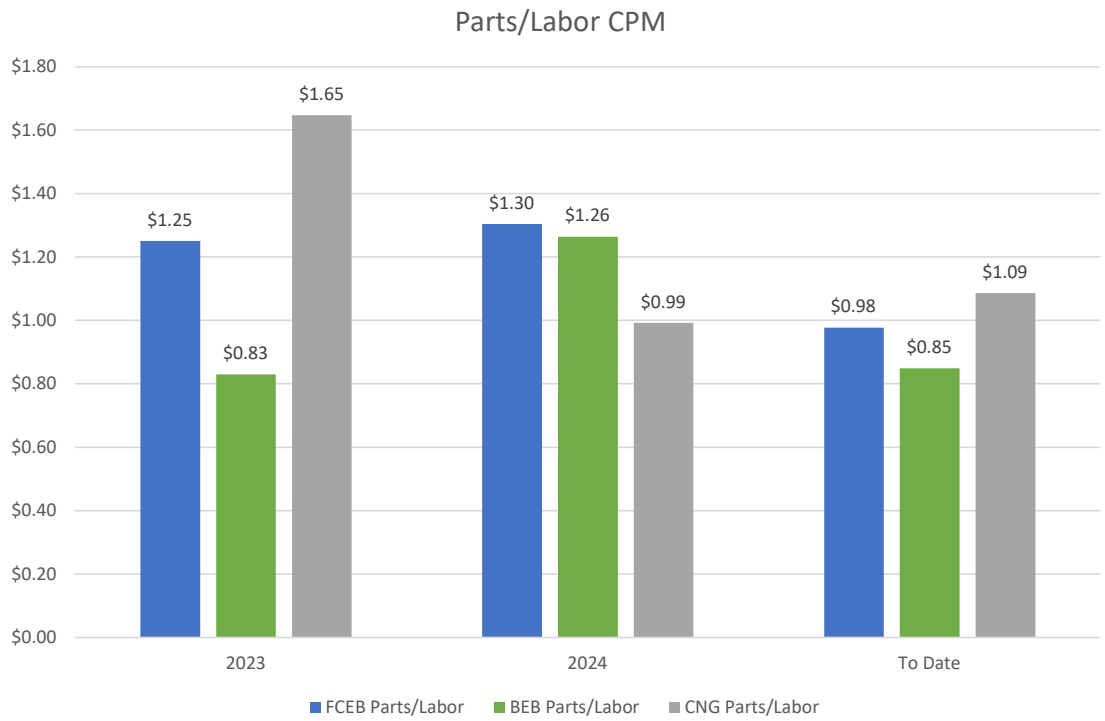




* O & M - Operation and Maintenance

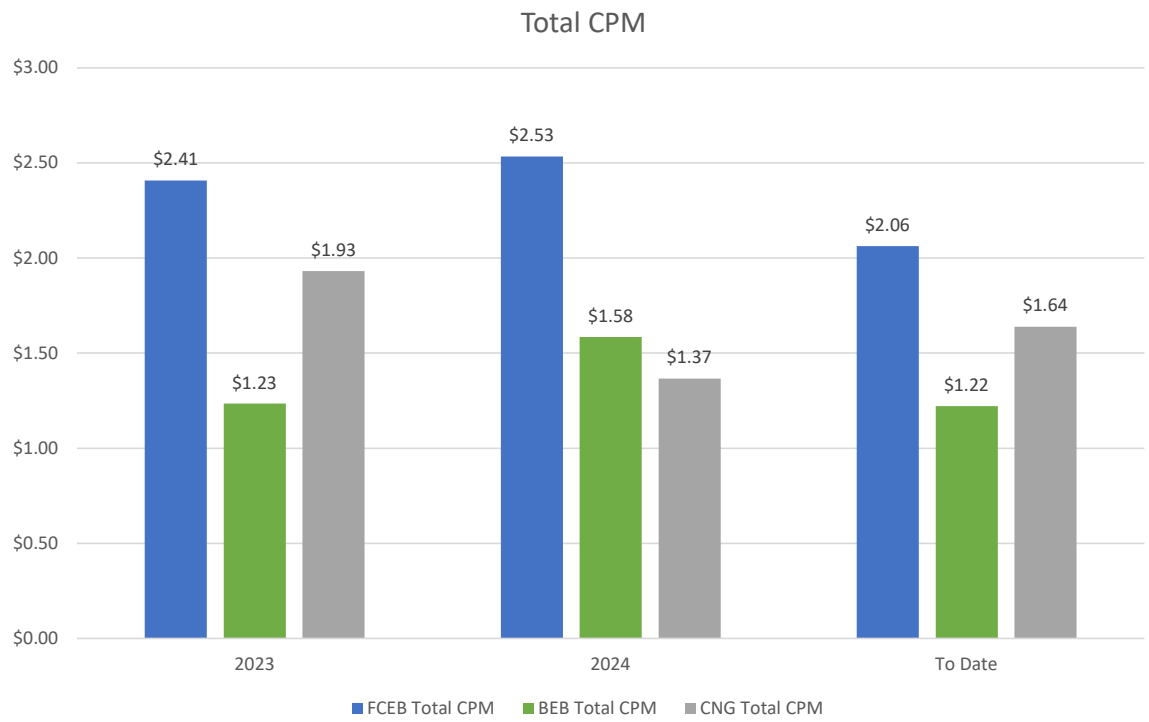
Cost per Mile – Parts/Labor

- FCEB increased due to parts costs
- BEB increased due to repairs outside of warranty
- CNG decreased due to completion of mid-life engine replacements



Cost per Mile - Total

- Total CPM includes
  - Fuel, Parts, and Labor
- To Date
  - FCEB 5-year average $2.06, 26% > CNG
  - BEB 2.5-year average $1.22, 34% < CNG



Infrastructure

BEB Charging Stations
- Located at the Garden Grove Base
- 10 Charging Stations
- 50-150kW each
- Fully Operational since 2024

Hydrogen Fueling Station
- Located at the Santa Ana Base
- 2 Dispensers
- 50 buses per day
- Fully Operational since 2020

Next Steps

- Accept
  - 40 additional 40ft FCEBs – receive all in 2026
  - Ten additional 40ft BEBs – receive all in 2026
  - Ten battery-electric paratransit vans – July 2025
- Install
  - BEB charging stations at Santa Ana Base - 2025 Q4
  - Battery-electric paratransit vans charging stations – 2025 Q4
- Procure
  - Second H2 Fueling Station at Garden Grove Base – award September 2025
  - Six additional 60ft FCEBs – award June 2025

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FOR A HEALTHY
COMMUNITY