LIVERMORE AMADOR VALLEY TRANSIT AUTHORITY

STAFF REPORT

SUBJECT: LAVTA 2026 Zero Emissions Transition Plan Update

FROM: Christy Wegener, Executive Director

DATE: May 4, 2026

Action Requested
Staff requests that the Board approve LAVTA's 2026 Zero Emissions Transition Plan Update.

Background
On December 14, 2018, the California Air Resources Board (CARB) enacted the Innovative Clean Transit (ICT) regulation, setting an unfunded mandate for California public transit agencies to have 100% zero-emission heavy-duty bus fleets by 2040. The regulation specifies the percentage of new bus procurements that must be zero-emission buses for each year of the transition period (2023–2040) and sets different purchasing milestones for small and large transit agencies.

In 2022, the LAVTA Board approved an ICT Rollout Plan (Plan) that identified a future zero-emission fleet comprised of 100% hydrogen fuel cell electric buses (FCEB). LAVTA's fleet transition strategy was to never purchase another internal combustion engine bus and instead replace each bus with an FCEB as they reach the end of their useful life. The ICT Plan as it was written achieved full zero emissions by 2034.

At the time the original Plan was developed, the assumptions about the long-term cost of both hydrogen as well as the cost of FCEBs were optimistic. However, the fuel-cell and hydrogen market has not developed as expected. Given a number of variables, including: the reduction in Federal and State discretionary funding, the high cost of hydrogen, the lack of availability of hydrogen, the high cost of FCEB rolling stock, the state of American bus manufacturers, the cost and timeline for infrastructure, and LAVTA's structural operating deficit, staff engaged with on-call consultant CTE (The Center for Transportation and the Environment) to update the Plan in order to consider a blended fleet of battery electric and FCEBs.

Discussion
Staff engaged with CTE in late 2025 on the Plan update, which is as Attachment 1. Staff will be joined by consultants from CTE during the May Board meeting to review the Plan methodology, assumptions, alternatives analysis, and recommendations.

Recommendation
Staff recommend that the Board approve the LAVTA 2026 Zero Emissions Transition Plan Update.

Strategic Plan Goal
Operational Effectiveness: Update assumptions made in the Zero Emission Bus transition plan and make recommendations for modifications.

Attachments:
1. LAVTA 2026 Zero Emissions Transition Plan Update

Attachment 1

CENTER FOR TRANSPORTATION AND THE ENVIRONMENT

Livermore Amador Valley Transit Authority (LAVTA) Transition Plan Updates

Submitted by the Center for Transportation and the Environment (CTE)
Submitted to LAVTA on 4/21/2026

Introduction

In November 2025, LAVTA contracted CTE to make updates to the transition planning analysis completed by CTE in 2020. CTE's scope of work includes making updates to cost projections based on 2026 assumptions and to develop two transition scenarios that will be compared to a baseline. These scenarios are as follows:

- Baseline
- Battery electric bus (BEB) & Fuel Cell Electric Bus (FCEB)
- FCEB Only

CTE developed a Zero-Emission Bus Smart Deployment Methodology to assist transit agencies, including LAVTA, through their zero-emission bus deployment programs. The cornerstone of CTE's approach is to ensure that the fleet operator matches the most appropriate propulsion technology to the intended use, operational strategy, and deployment situation. To update LAVTA's transition planning analysis, CTE revisited each stage of the analysis to update the projections for the baseline and two transition scenarios.

CTE began the transition plan updates by conducting a planning meeting with LAVTA staff to review the project objectives, scope, approach, tasks, assignments, and timeline. CTE then held an "Assumptions Workshop" where the assumptions that were used to guide the analysis were discussed and confirmed. This included reviewing the assumed existing conditions from the previous analysis and discussing how conditions (such as fleet composition, replacement schedules, blocking, etc.) have changed since 2020. CTE also collected service, fleet, operational, maintenance, and facilities information to define the baseline conditions. Using this information, CTE performed service, fleet, facilities, fuel, maintenance, and TCO assessments for LAVTA's fleet. Based on CTE's results, LAVTA has elected to pursue the BEB and FCEB mixed fleet scenario. The results of the assessments are discussed in detail in the following sections.

Service Assessment

Assumptions

For the service assessment, CTE assumed that all LAVTA's routes would continue to operate on their current schedule and that blocking and annual mileage would not change significantly. It was also assumed that block assignments by vehicle length are consistent throughout the transition period. When modeling BEB operations, CTE assumed that the top 5% and bottom 5% of the battery capacity is unusable based on recommended operations to conserve battery health and assumed that 10% of the battery is degraded, which is equivalent to a midlife level of degradation. These compounded assumptions result in only 82% of the battery being assumed to be usable. With technology advancements, CTE assumed 5% improvement in battery capacity every other year. When modeling FCEBs, CTE assumed 94% maximum fill of the fuel cell tank and that there is 2.1kg residual hydrogen mass in the empty tank, which is unavailable for operation. CTE also assumed that fuel cell system efficiency degrades by 20% every 6 years.

Conclusions

CTE determined that for the 35' bus length, BEBs reach 93% feasibility by 2026, and 100% in 2030. For the 40' bus length, BEBs reach 89% feasibility by 2026 and 98% in 2030. FCEBs are expected to reach 100% feasibility in 2030. Since there is not currently a 35' FCEB available, it was assumed that the 35' bus would have a similar performance specification to the 40’ bus and would become available in 2030. Therefore, fuel cell buses show a stronger feasibility than BEBs. However, having a mixed fleet of FCEBs and BEBs would also satisfy LAVTA’s service requirements based on the feasibility of each propulsion type.

Fleet Assessment

Assumptions

Fleet Replacement and Composition Assumptions

CTE confirmed that as of 2025, LAVTA has thirteen 30’, ten 35’, and thirty-seven 40’ hybrid buses. This excludes seven contingency buses. In 2027, four additional 40’ hybrid buses will enter service, and four 30’ hybrid buses will be replaced with four 35’ hybrid buses. Four additional 40’ FCEBs will also enter service in 2030, meaning the total bus count in 2030 will be 68 buses including 64 hybrids and four FCEBs. CTE assumed that fleet composition (e.g. vehicle length, division) remains constant throughout the transition plan, except for the known vehicle replacements and planned additions previously mentioned. The fleet replacement timing is based on known procurement plans. A 12-year replacement cycle is assumed except for the vehicles being replaced prior to 2030, which will operate longer than 12 years while the replacement buses are being manufactured. CTE used a 1:1 replacement strategy so that fleet size will not increase to accommodate BEB range limitations. CTE also assumed that the purchase order for future buses is issued two years prior to the deployment year.

Innovative Clean Transit (ICT) Purchase Requirement Assumptions

CTE assumed that ICT zero-emission bus (ZEB) purchase requirements would phase in as follows: 25% in 2026, 25% in 2027, 25% in 2028, 100% in 2029. These percentages represent the required share of new bus purchases that must be zero emission if an order is placed in a given year. Fleet assessments will meet minimum ICT requirements with purchases assumed to be only 25% ZEB until 2029. From 2029 onward, CTE assumed 100% ZEB procurement, contingent on scenario feasibility.

Bus Cost Assumptions

CTE calculated hybrid bus costs based on LAVTA’s most recent procurement costs. BEB and FCEB costs are based on the Washington State Contract and verified against recent procurements CTE has participated in. Since there is not currently a commercially available 35’ FCEB, these vehicle costs are assumed to be the same as 40’ FCEB procurement costs. Pricing remains level over the transition period except for inflation, which is factored in by applying a 3% annual escalation, consistent with LAVTA’s capital planning inflation assumption. The transition plan assumed vehicle purchase costs align with the year of deployment.

Conclusions

With LAVTA’s chosen scenario of a mixed fleet of BEBs and FCEBs, six 40’ FCEBs will enter service in 2030, purchased in 2028 to meet the 25% ICT minimum required, as shown below in Figure 1. Four of the six 40’ FCEBs are additions to the baseline fleet and two are replacements. From 2031 onward, all buses entering service are BEBs. A single FCEB procurement is assumed, consistent with a small-scale hydrogen fueling station. This scenario results in 74% ZEB transition by 2040. The total cost over this transition plan is $126.8M, compared to $118.4M for the baseline fleet and $155M for the FCEB only fleet.

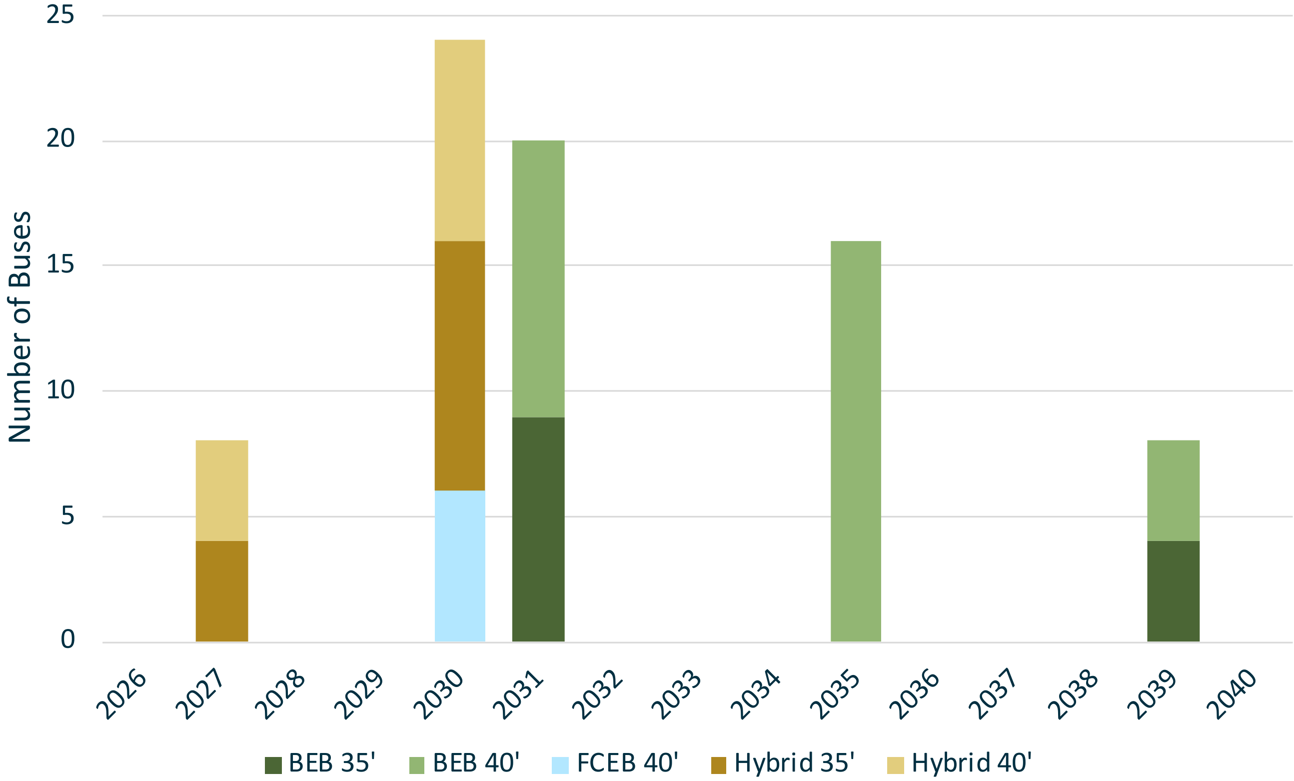

Figure 1: Fleet Deployment Schedule - BEB and FCEB Mixed Scenario

Fuel Assessment

Assumptions

General Assumptions

CTE used LAVTA's hybrid bus mileage to define annual mileage across all vehicle types. To estimate fuel consumption for the hybrids, CTE applied LAVTA's average gallon per year per vehicle type. For BEBs, CTE used a nominal fuel economy to estimate kWh consumption and defined demand assuming two buses per charger, 180 kW per charger, and 85% charger efficiency. Finally, for FCEBs, CTE used the nominal fuel economy to estimate hydrogen consumption. CTE also assumed FCEB fuel cell system efficiency degrades by 20% every six years. A boil-off loss percentage was applied when using a liquid hydrogen station due to liquid hydrogen evaporating into gas. CTE adjusted fuel prices using EIA transportation cost percentages and inflated costs using a 3% CPI assumption.

Fuel Cost Assumptions

Table 1: Fuel Cost Assumptions

Fuel	Cost	Source
Diesel	$3.5/gal	LAVTA
Hydrogen (gaseous)	$26/kg	Based on First Element Livermore costs
Hydrogen (liquid)	$12/kg	Based on AC Transit costs
Electricity	$0.15475/kWh $95.56/50 kW	Based on PG&E's Electric Schedule BEV-2-S Commercial Electric Vehicles for Secondary Voltage off-peak rate

Conclusions

With LAVTA's chosen scenario of a mixed fleet of BEBs and FCEBs, the total fuel cost of the BEBs will remain lower than FCEBs even with more BEBs in the fleet, as shown below in Figure 2. Hydrogen costs increase annually due to fuel cell system degradation, which decreases vehicle efficiency and increases fuel consumption. Fuel consumption increases over time up to year six, when the FCEB undergoes a fuel cell replacement. After replacement, the fuel consumption returns to a level similar to the first year of service. The average fuel cost per mile over the transition is as follows: BEBs - $0.3/mi, FCEBs - $3.2/mi, and hybrids - $0.7/mi. The total cost over the transition is $26.6M, compared to $29.6M for the baseline scenario and $40.6M for the FCEB only scenario.

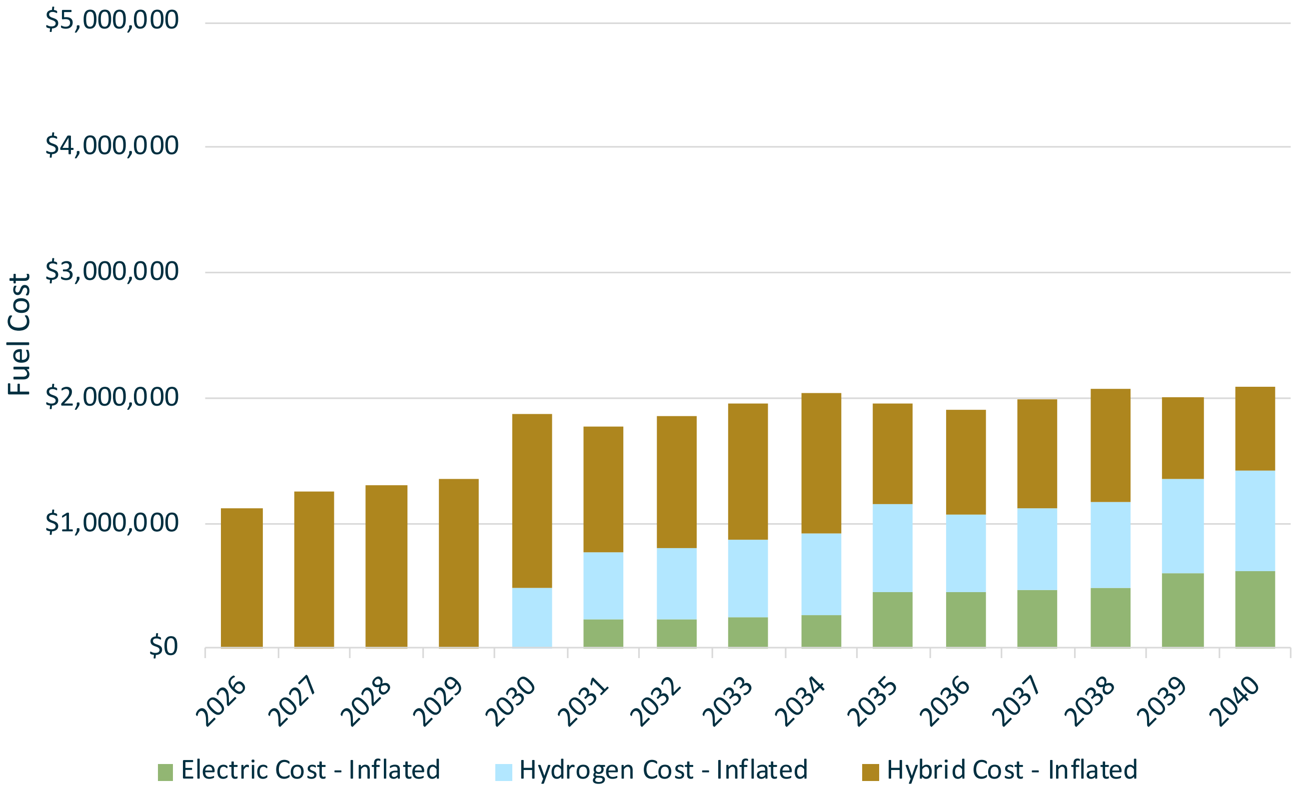

Figure 2: Annual Fuel Cost by Fuel Type - BEB and FCEB Mixed Scenario

Maintenance Assessment

Assumptions

Hybrid Buses

CTE assumed an annual maintenance cost of $48,331 per hybrid bus based on LAVTA's data. CTE estimated overhauls every six years at a cost of $72,500 per hybrid bus based on LAVTA's data. CTE also included an annual cost of $12,000 for the maintenance of the diesel fueling facility.

FCEBs

CTE assumed maintenance costs of $15,900 per FCEB based on CTE's other project work. Through a different project CTE has collected detailed maintenance data sets from U.S. transit agencies to update the average maintenance costs overtime for transit buses. CTE used this database to calculate maintenance costs for the FCEBs, based on data from California agencies. CTE estimated overhauls every six years at a cost of $200,000 per FCEB based on data from Orange County Transportation Authority's fleet. CTE also included annual operations and maintenance (O&M) costs of $180,000 for maintenance of the gaseous fueling station and $300,000 for maintenance of the liquid fueling station.

BEBs

CTE assumed maintenance costs of $27,700 per BEB based on CTE's database data. CTE used the same database as previously mentioned for calculating FCEBs but used data from agencies outside California. CTE multiplied this data by LAVTA's labor rate to get a closer approximation. CTE estimated overhauls every six years at a cost of $137,000 per BEB based on CTE's data from recent projects. CTE also included annual O&M costs of $3,000 per charger.

Conclusions

With LAVTA's chosen scenario of a mixed fleet of BEBs and FCEBs, there are higher maintenance costs due to overhauls of hybrids in 2033 and 2036, FCEBs in 2036, and BEBs in 2037, as shown below in Figure 3. With these increased costs, the total maintenance cost over the transition is $60.1M, compared to $66.8M for the baseline scenario and $57.7M for the FCEB scenario.

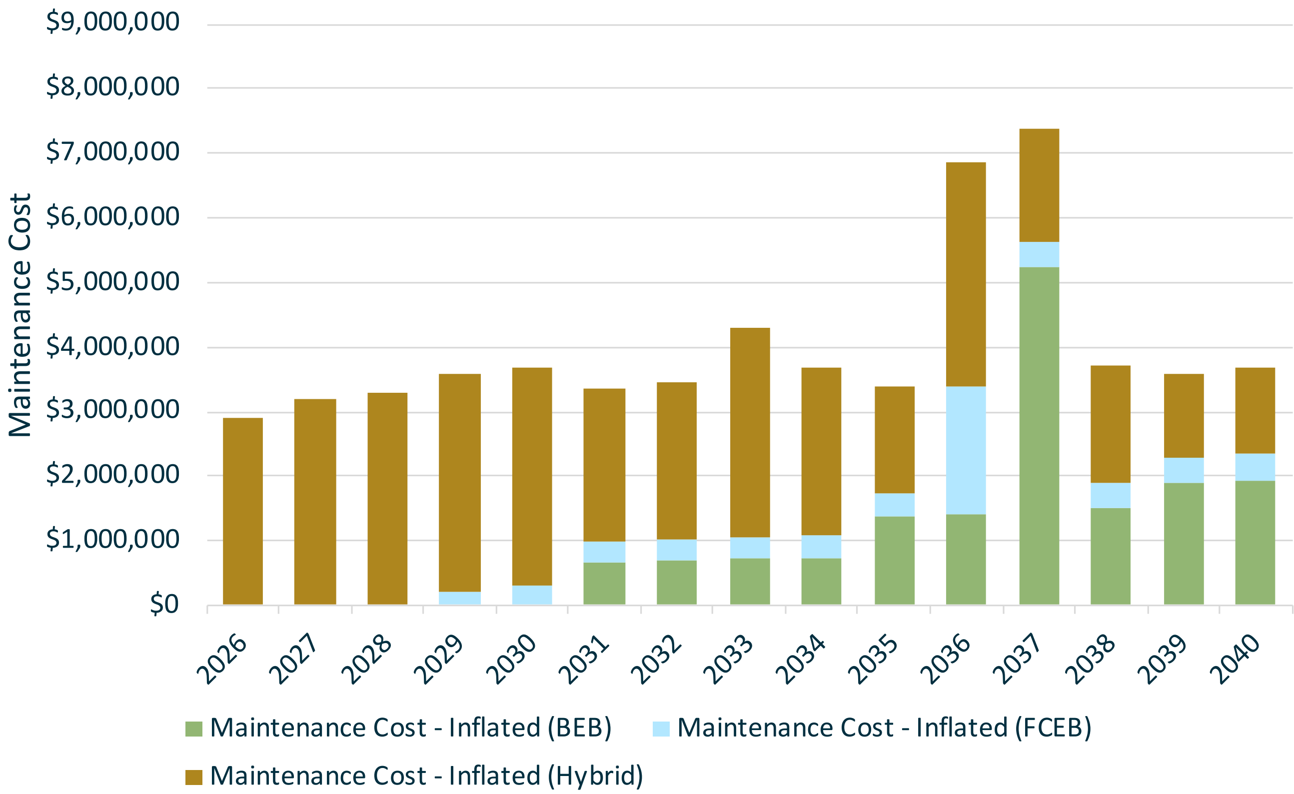

Figure 3: Annual Maintenance Cost by Fuel Type - BEB and FCEB Mixed Fleet Scenario

Facilities Assessment

Assumptions

Hydrogen Stations

CTE assumed a cost of $6M for a small-scale gaseous hydrogen station capable of supporting up to 12 FCEBs, based on CTE's data from recent projects. CTE recognizes that there are a wide range of available options with large variation in complexity and costs, making this assumption conservative. The assumption includes all costs except O&M and fuel, which are captured in the previous assessments. CTE assumed a permanent large-scale liquid hydrogen station costs $12M, based on CTE's data from recent projects. This includes all costs except O&M and fuel, which are captured in the previous assessments.

Charging Infrastructure

CTE assumed a charger cost of $76,000 and dispenser cost of $19,000, based on CTE's recent procurement data. CTE also assumed ~$4,000 per charger installation based on recent data from Broome County in New York. CTE used values from LAVTA's 2021 transition plan, which used electric infrastructure cost assessments completed with AECOM. These values were inflated to the current year and included $300,000 for infrastructure planning. AECOM's work also included two phases of trench and duct bank work and two phases of switchboard and pad work. These coincide with the two assumed power upgrades included – one in 2030 before the first BEB deployment and another in 2034 before the deployment of the following 16 BEBs. CTE assumed the transformer cost is covered by PG&E, but this will require confirmation through further discussion. CTE applied 10% for design engineering and 20% contingency to power upgrade costs.

Conclusions

With LAVTA's chosen scenario of a mixed fleet of BEBs and FCEBs, the cost of a small-scale gaseous hydrogen station is applied in 2030 when six FCEBs enter service, as this represents the full FCEB fleet, and the station has sufficient capacity to support them. Charger site costs are applied in 2030 (infrastructure planning + Power Upgrade Phase 1) and in 2034 (Power Upgrade Phase 2). Chargers and dispensers are added as additional BEBs are deployed. This is all captured below in Figure 4. It is assumed one charger per two buses and one dispenser per bus. The total facilities cost over the transition is $11.3M, compared to $6.8M for the baseline scenario and $13.5M for the FCEB scenario.

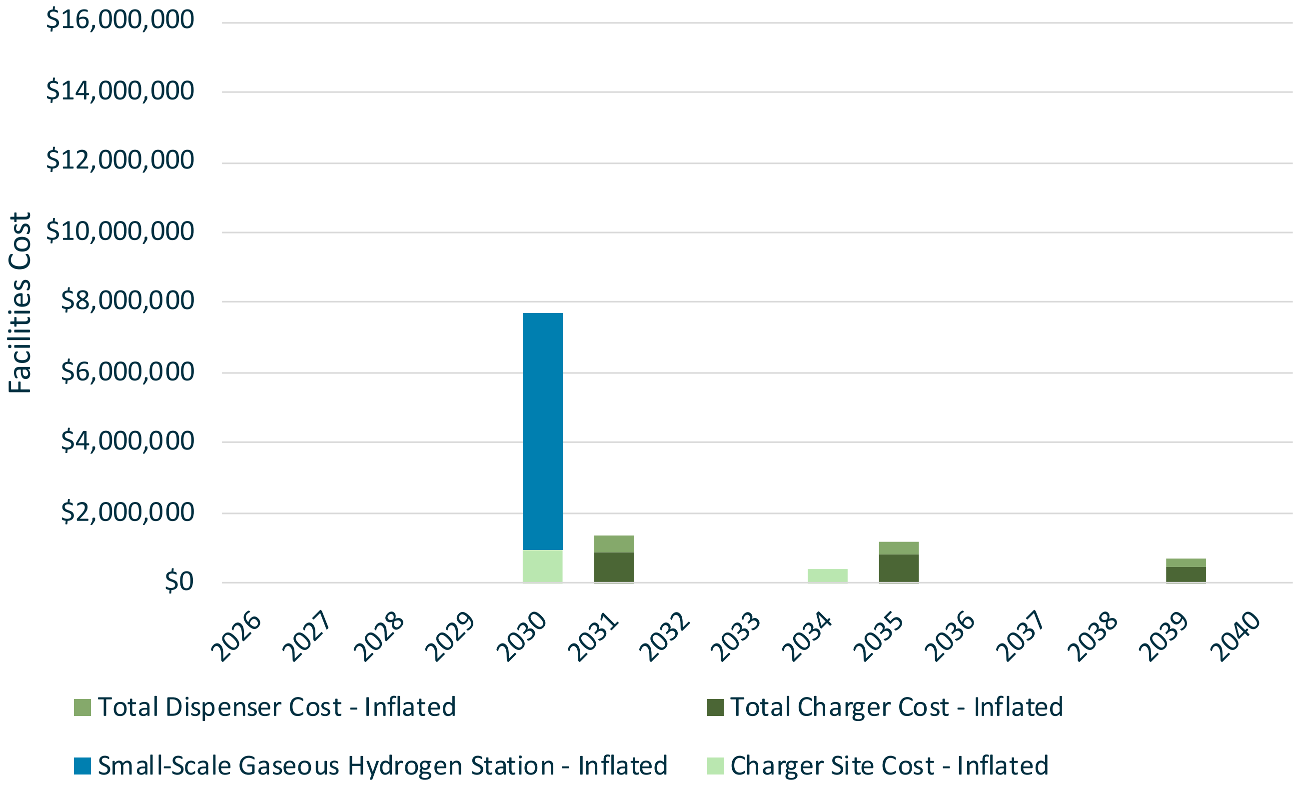

Figure 4: Annual Facilities Cost - BEB and FCEB

TCO Assessment

Assumptions

The total cost of ownership for each scenario includes vehicle costs, fuel costs, maintenance costs, and facilities costs. The total cost of ownership is calculated as the sum of all categories, with a 3% annual CPI escalation applied to each category.

Conclusions

As shown in Figure 5, with LAVTA's chosen scenario of a mixed fleet of BEBs and FCEBs, the total CAPEX costs over the course of the transition are $165M, and the total OPEX costs are $86.6M, with a total cost over the transition of $251.6M.

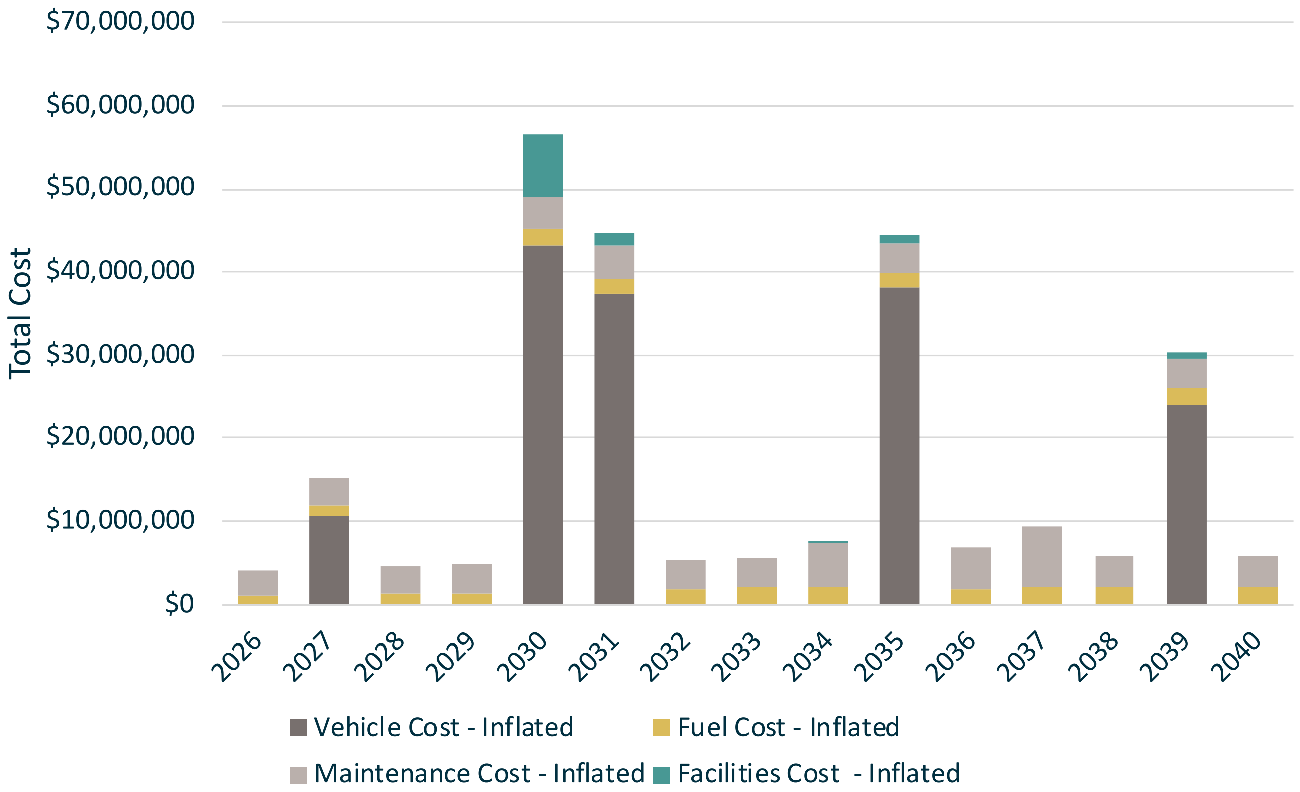

Figure 5: Annual Total Cost of Ownership - BEB and FCEB Mixed Fleet Scenario

Table 2 summarizes all costs associated with the transition for each fleet scenario.

Table 2: TCO Summary

Scenario	Vehicle Cost	Fuel Cost	Maintenance Cost	Facilities Cost	TCO
Baseline (no transition)	$143.2M	$29.6M	$66.8M	$6.8M	$246.4M
BEB and FCEB*	**$153.7M**	**$26.6M**	**$60.1M**	**$11.3M**	**$251.6M**
FCEB Only	$189.7M	$40.6M	$57.7M	$13.5M	$301.5M

*Selected transition scenario