




LAVTA ZEB Transition Study Update

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CARB Innovative Clean Transit Regulation

100% ZEB Fleet by 2040 is not a mandate, but a goal

There is only a *purchasing* mandate:

ZEB Purchase Requirements

| Starting January 1 | ZEB Percentage of Total New Bus Purchases |
|--------------------|---|
| 2026 | 25% |
| 2027 | 25% |
| 2028 | 25% |
| 2029 | 100% |

- Small CA Transit Agencies (<100 buses) are required to submit a board-approved ZEB Rollout Plan by **July 1, 2023**.

Battery Electric Buses & Fuel Cell Electric Buses



Battery Electric Buses (BEB)

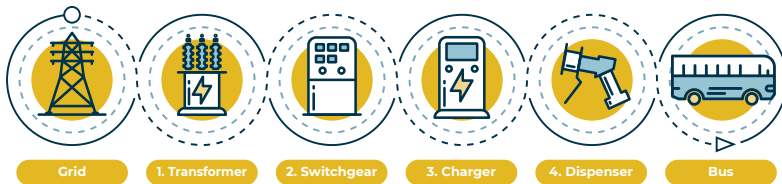
- May need to increase fleet size
- Fueling time longer than ICE* bus
- Fuel cost highly variable. Could be higher or lower than fossil fuels
- BEB bus cost approximately 50% higher than LAVTA diesel bus
- Infrastructure costs increases per bus when scaled up

*Internal Combustion Engine

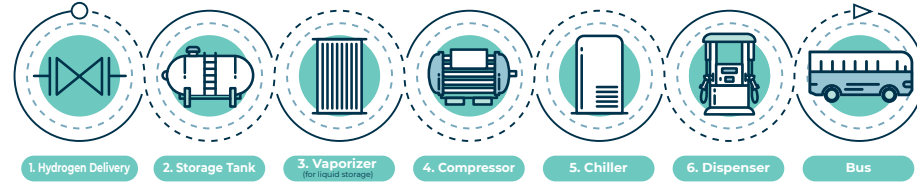
Fuel Cell Electric Buses (FCEB)

- Comparable range to ICE* bus – 1:1 replacement ratio
- Fueling time comparable to ICE bus
- Fuel cost moderately higher than fossil fuel
- Bus cost 70% higher than LAVTA diesel bus
- Infrastructure costs reduce per bus when scaled up
- Greater resilience
- Fewer entrants in market compared to BEB

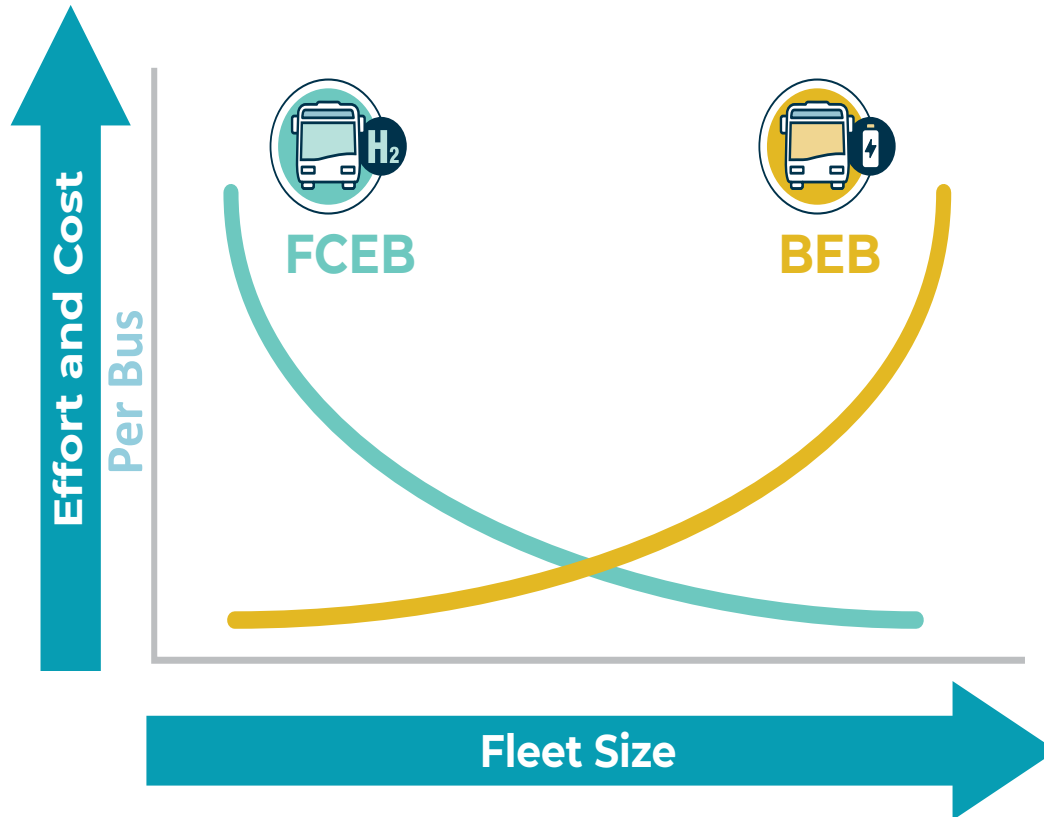
BEB Fuel Delivery Pathway



FCEB Fuel Delivery Pathway

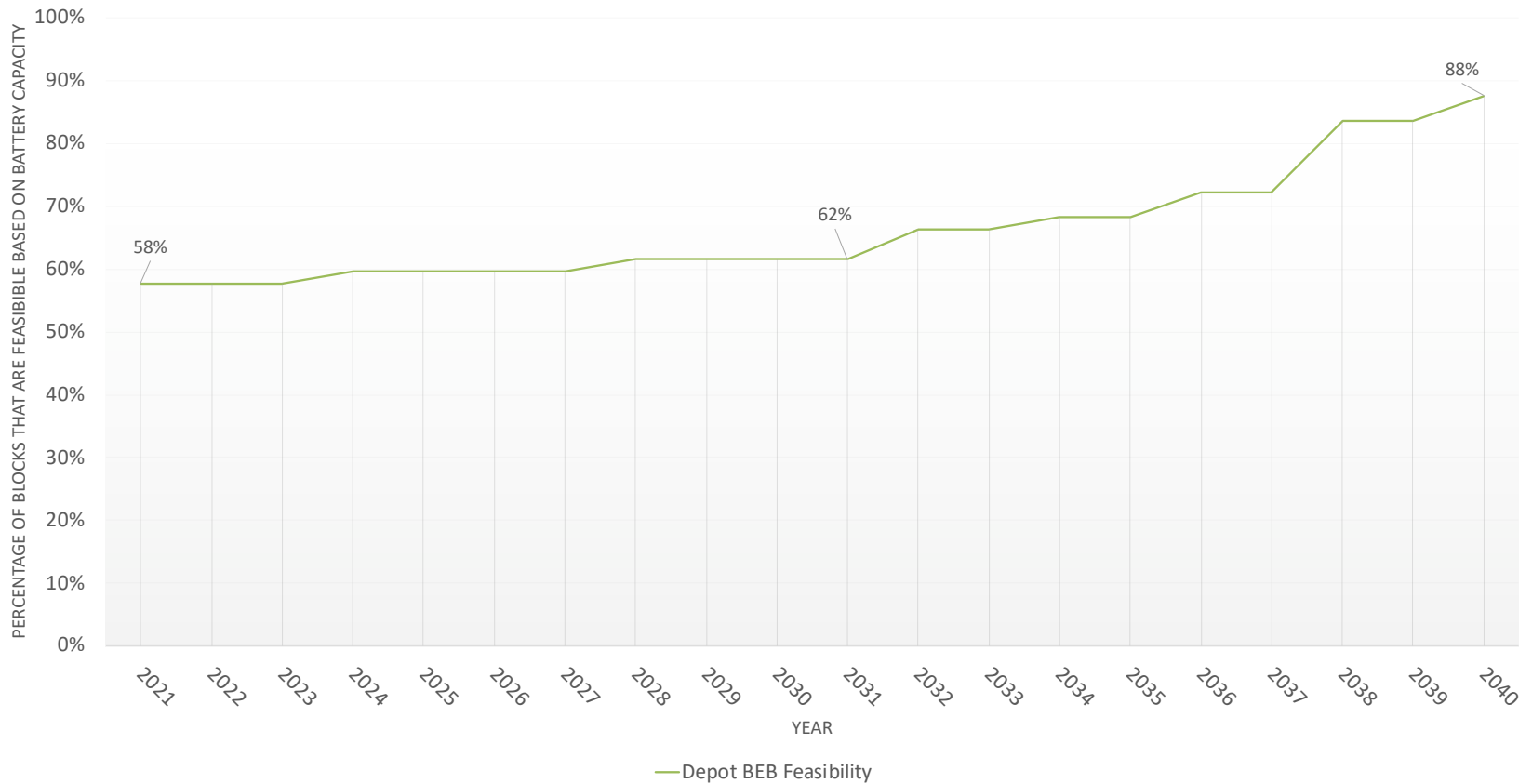


ZEB Infrastructure Scalability



- FCEB: High initial cost for H₂ fueling stations can be leveraged over many buses in larger fleets
- BEB: More equipment and infrastructure is needed to support larger fleets

Overnight Depot-Charged BEB Service Feasibility



ZEB Technology Fleet Transition Scenarios

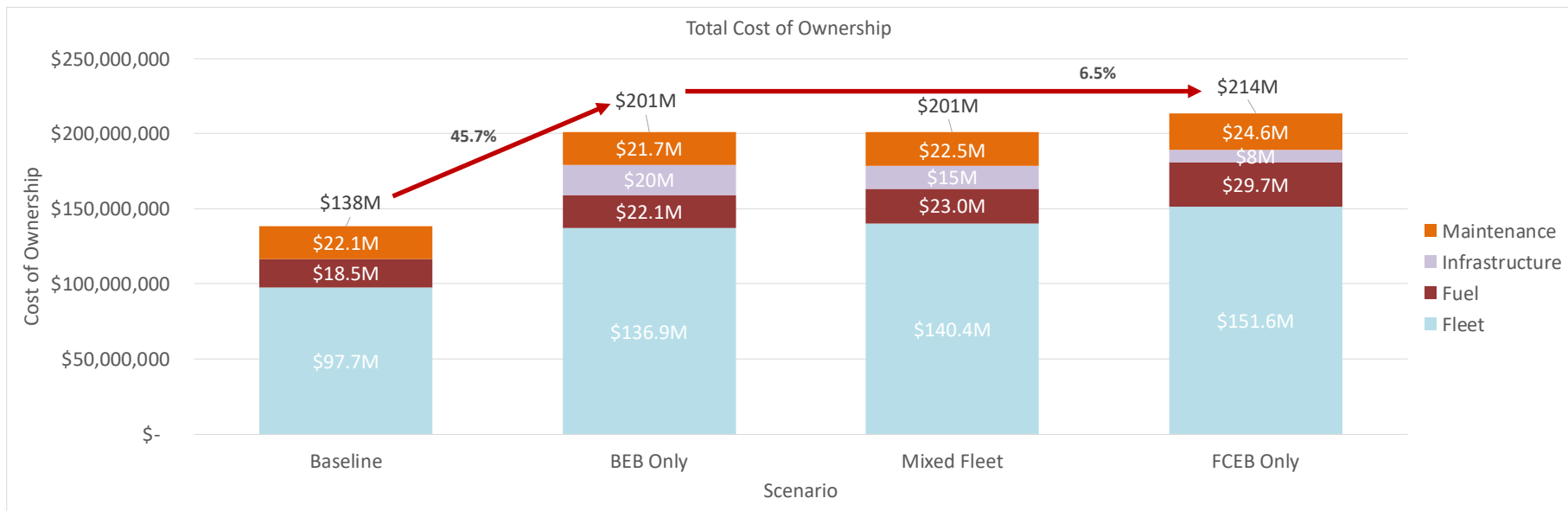


Additional ZEB technology solutions are required to achieve a 100% zero-emission fleet transition

- Depot & on-route charged battery-electric buses (BEBs)
- Depot charged battery-electric buses (BEBs) & fuel cell electric buses (FCEBs)
- Fuel cell electric buses (FCEBs) only

Total Cumulative Capital & Operating Costs

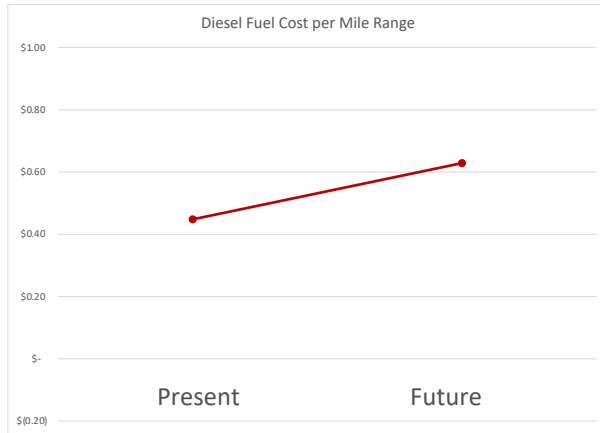
All Scenarios, 2021-2040



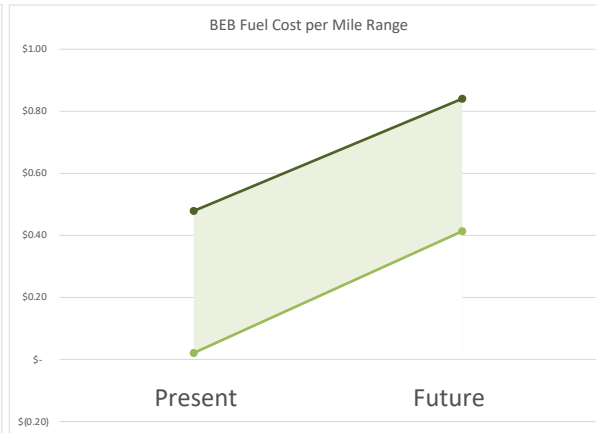
TCO Varied Fuel Pricing Assumptions

- Fuel Pricing
 - Hydrogen fuel pricing may vary from today's transit market pricing of \$0.95/mile to -\$0.05/mile. This lower price reflects market costs offset by LCFS credit revenue from Dairy Gas SMR H₂.
 - Electricity fuel pricing may vary from today's transit market rate of \$0.02/mile with LCFS credit to \$0.84/mile without LCFS credit and PG&E scheduled upgrades.*
 - Over time the LCFS Credit Value is projected to decrease at a rate of about 3% per year based on historical depreciation and reduced need for market incentives as market matures.
 - To qualify for 100% Renewable LCFS credits for electricity, LAVTA plans to purchase Renewable Energy Credits (RECs).

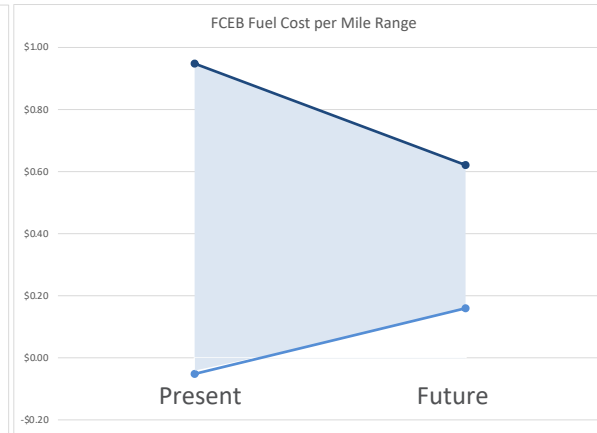
Fuel Cost per Mile Range Potential Over the Transition Period



— Diesel Cost per Mile

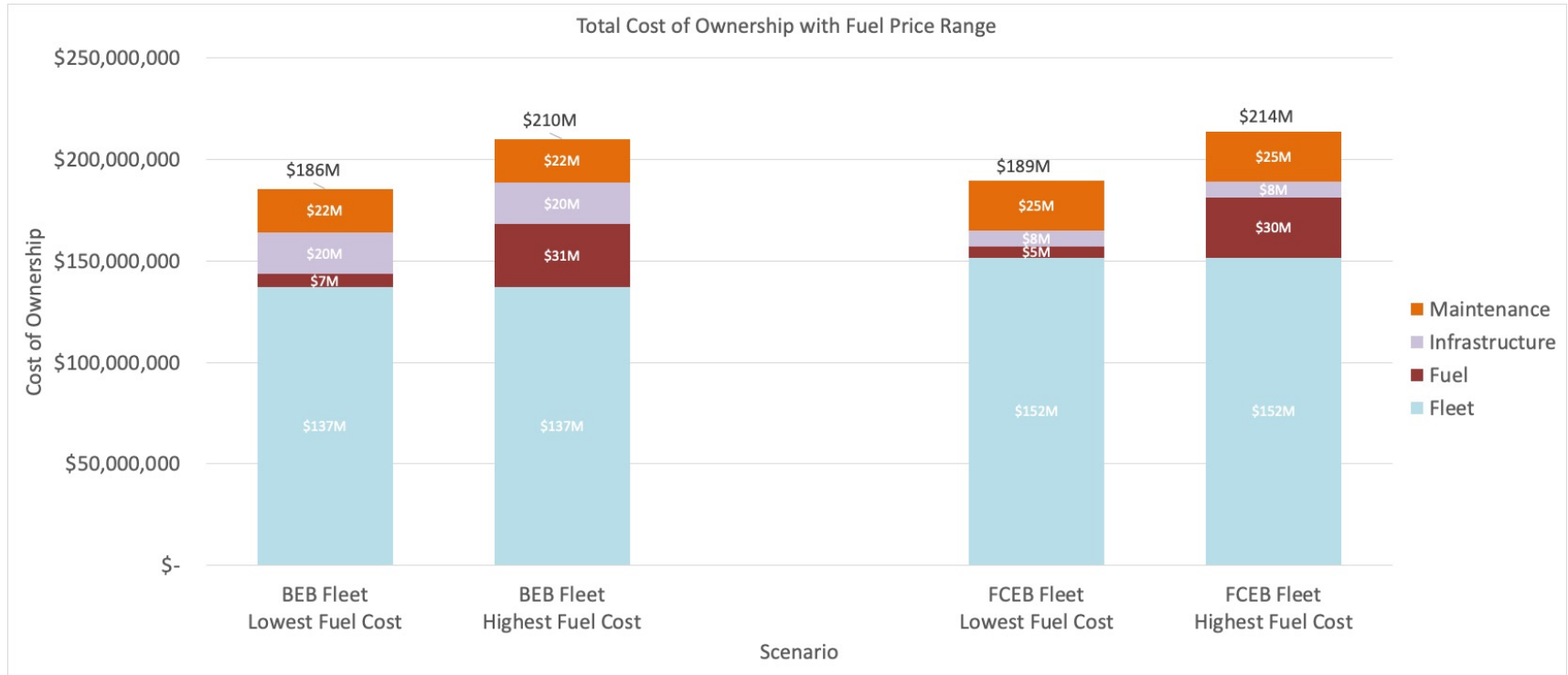


— E- Cost Per Mile Range
— E- Cost Per Mile
— Net Cost with LCFS Revenue and REC Expense



— H₂ Cost Per Mile Range
— Net Cost with LCFS Revenue
— H₂ Cost Per Mile

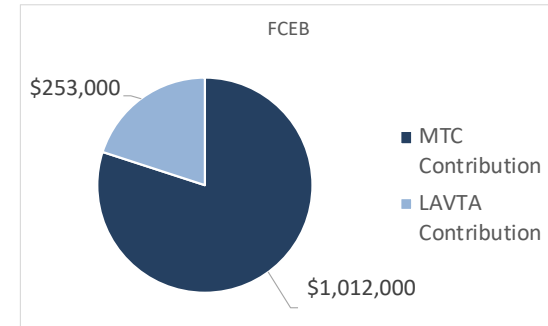
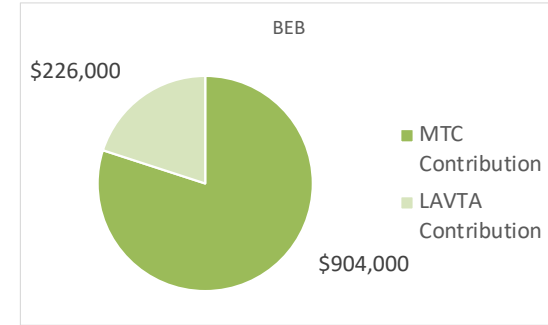
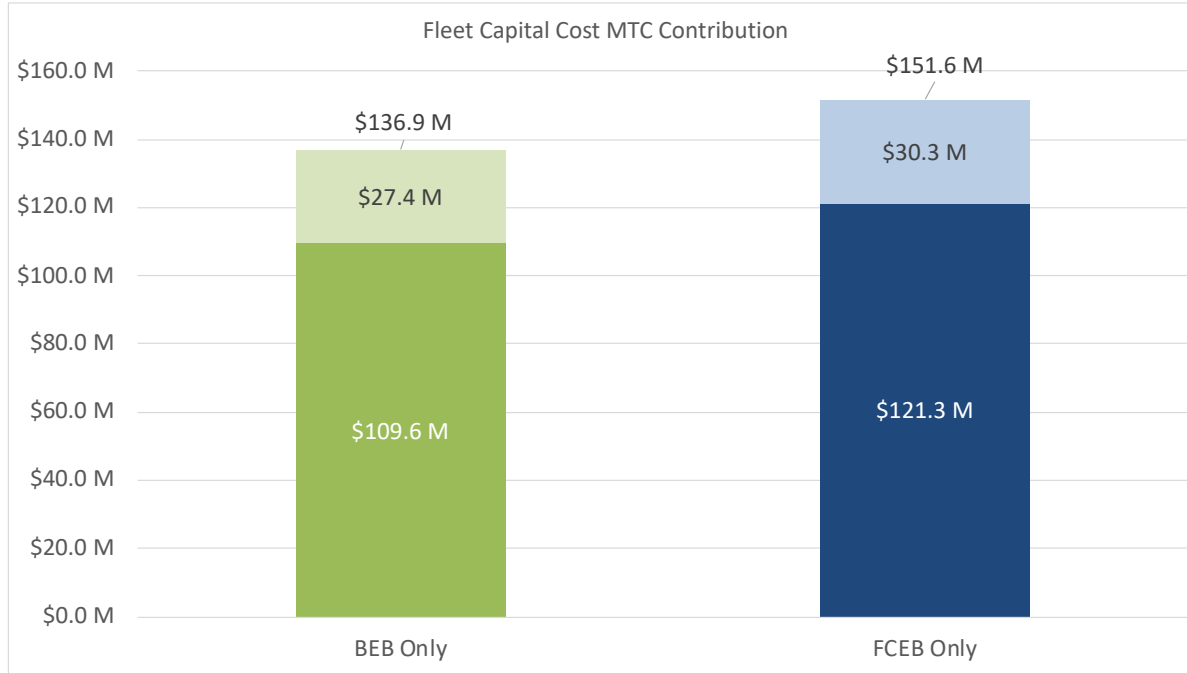
Total Cost of Ownership with Fuel Price Range



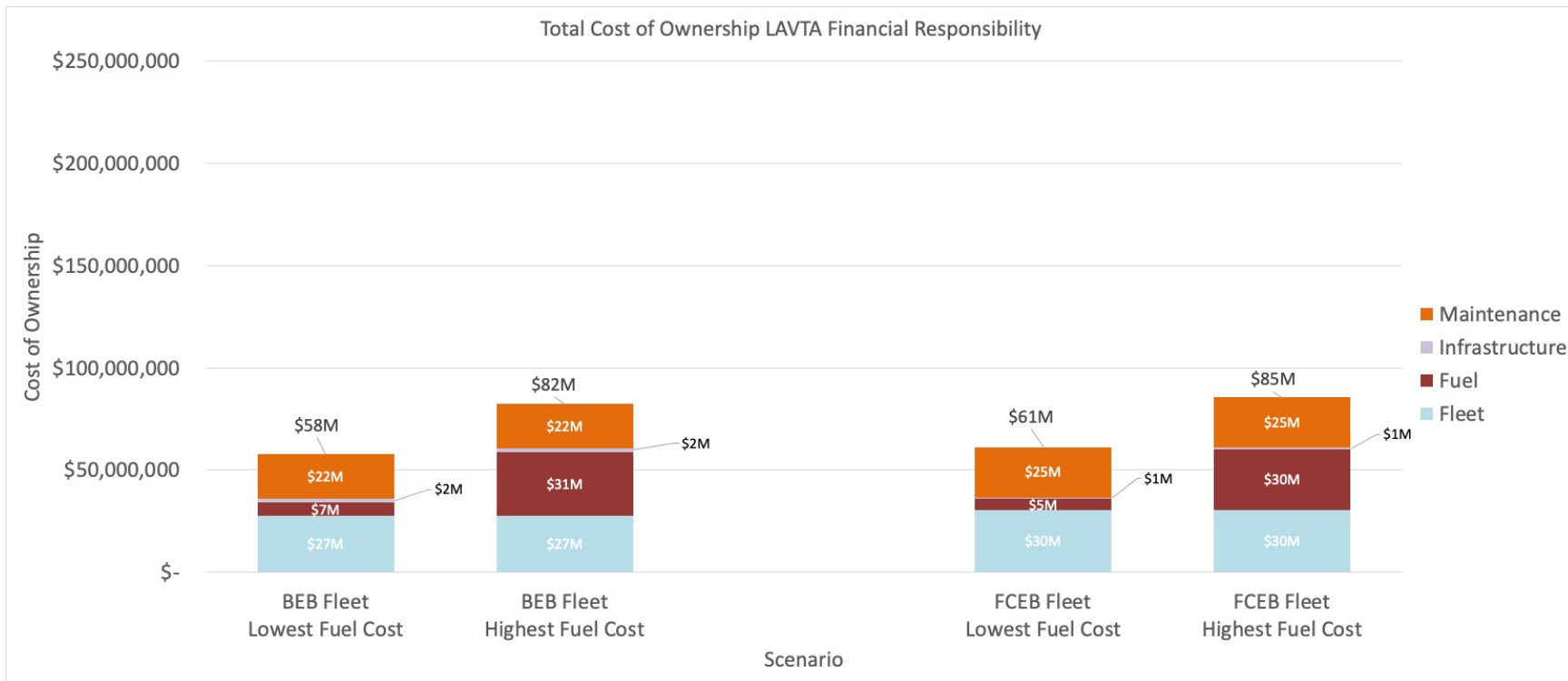
TCO Cost Share Pricing Assumptions

- The inclusion of federal and state funding offsets the financial risk to LAVTA.
 - *Bus Capital*: MTC expected share 80% of vehicle purchase expense
 - *Infrastructure*: Federal grants offer up to 90% cost share.

Total Cumulative Bus Capital Costs with MTC Cost Share



Total Cost of Ownership: LAVTA Financial Responsibility



LAVTA Staff Recommendation: FCEB

- FCEBs provide greater flexibility and convenience in deployment planning due to greater comparable range and shorter fueling time than BEB.
- General expectation that H₂ fuel prices will trend lower in next decade, with growing opportunities for green hydrogen.
- Opportunities to leverage economy of scale with Valley Link project.
- Stronger service resilience following a major disaster.
- Less infrastructure needed at Atlantis and transit centers.
- Higher reported availability than BEB*

** AC Transit ZETBTA report (Part 1)*

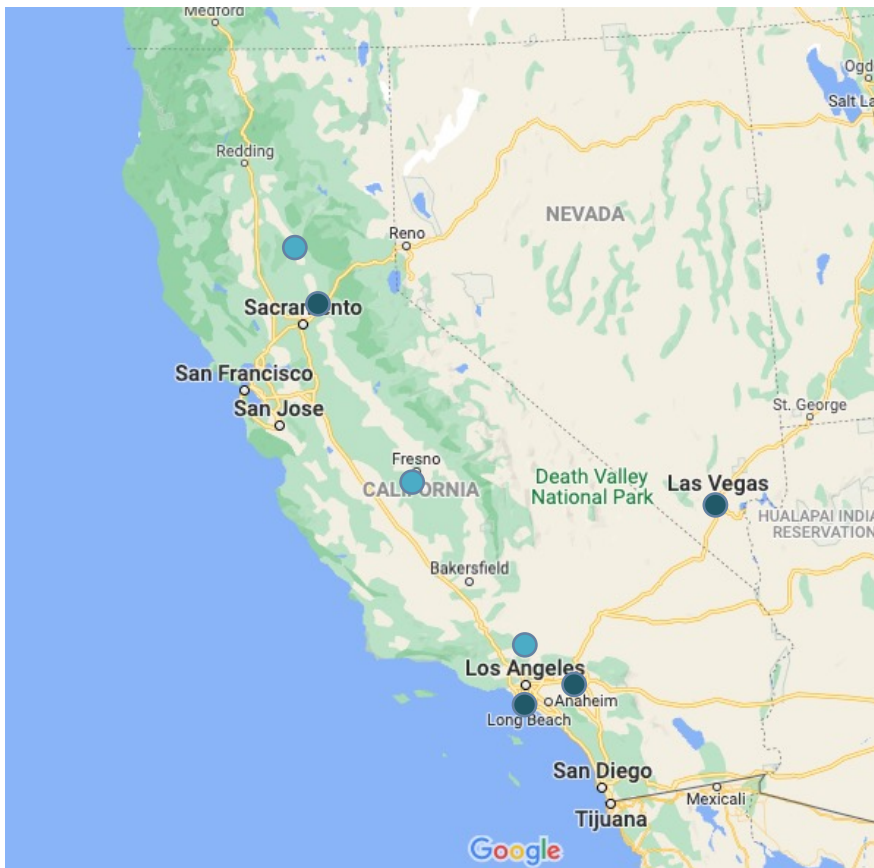
Performance Data

Fleet availability – a measurement of the vehicle readiness status for morning pull out at 7 a.m.

Miles between road calls (MBRC) – an indicator that measures the vehicle miles between mechanical failures during revenue service

| Jul 2020 – Dec 2020 | BEB | FCEB |
|---------------------|-------|--------|
| Fleet availability | 57% | 90% |
| MBRC | 8,109 | 10,406 |

Hydrogen Production Centers

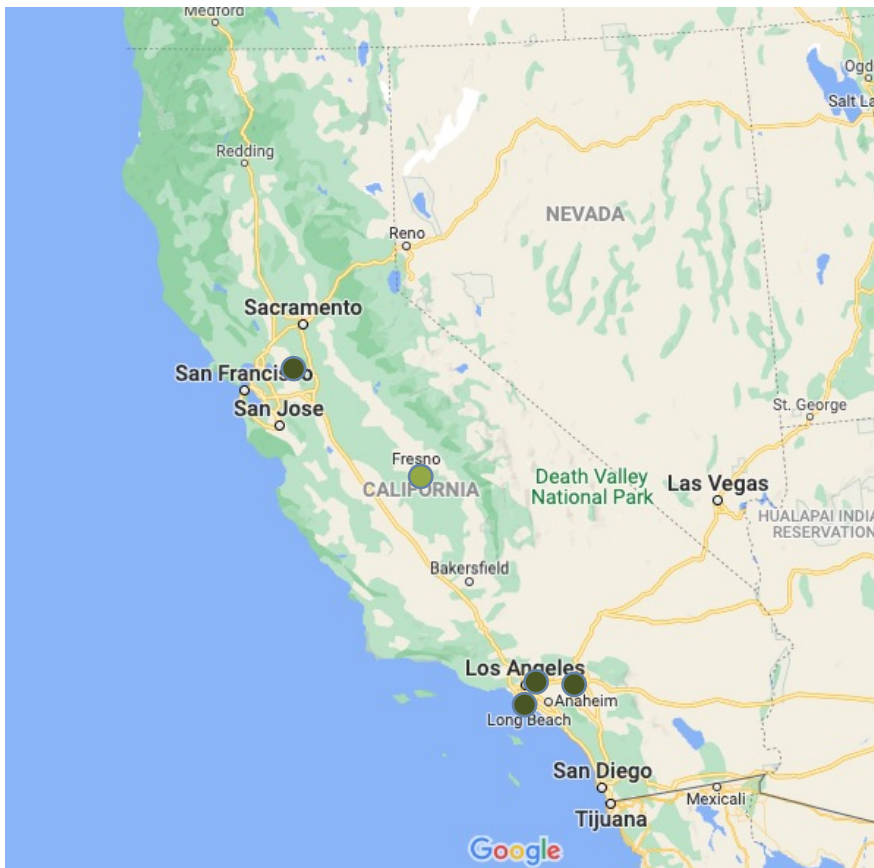


Hydrogen Producers

1. Air Liquide (Las Vegas)
2. Air Products (Sacramento & Los Angeles)
3. Linde (Ontario, CA)
4. *Plug Power (Fresno) – Proposed*
5. *SG2 H2 Energy (Butte & Lancaster) – Proposed*

 **Proposed Hydrogen Production Centers**
 **In-Service Hydrogen Production Centers**

Hydrogen Storage & Distribution Centers



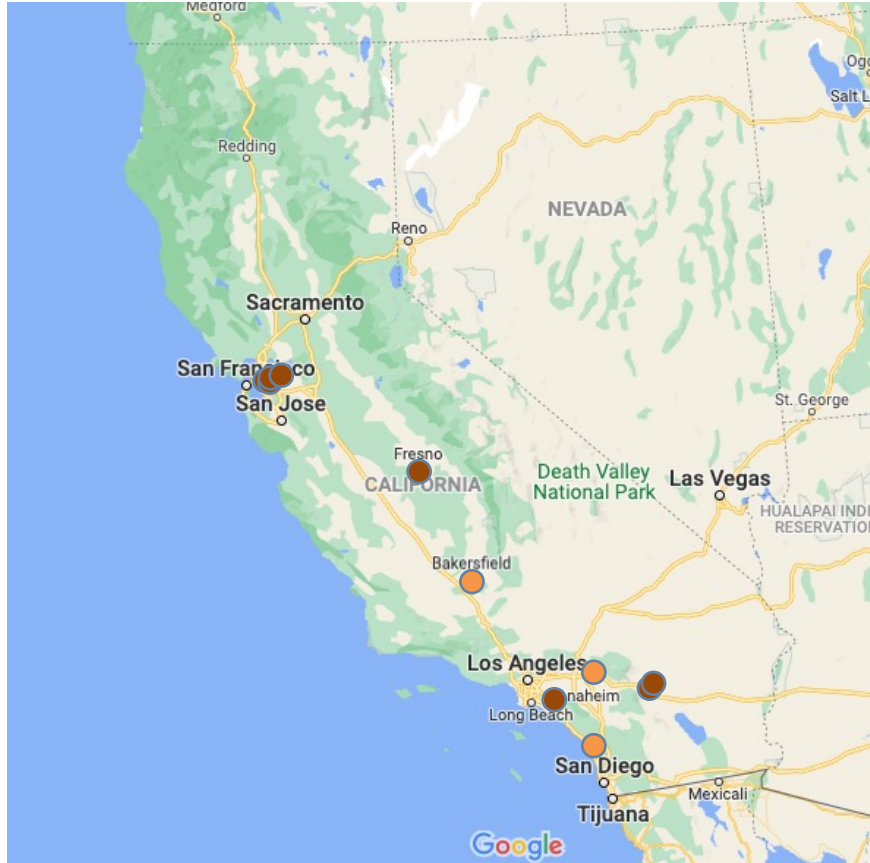
Distribution Center Operators

1. First Element (Livermore)
2. Shell (Los Angeles & Port of Long Beach & Ontario)
3. *Plug Power (Fresno) – Proposed*

● *Proposed Hydrogen Distribution Hubs*

● *In-Service Hydrogen Distribution Hubs*

Medium/Heavy Duty Fueling Stations



Med/Heavy Fueling Stations

1. AC Transit (Emeryville & Oakland)
2. OCTA (Santa Ana)
3. Sunline (Thousand Palms & Indio - *proposed*)
4. First Element (Oakland & Fresno & Livermore)
5. *Golden Empire Transit (Bakersfield) – Proposed*
6. *North County Transit (Oceanside) – Proposed*
7. *Foothill Transit (Pomona) – Proposed*

-  **Proposed Med/Heavy Duty Fueling Station**
-  **In-Service Med/Heavy Duty Fueling Station**

FCEB Project Process & Risk Mitigation Plan



Bus Timeline



Facility Timeline

with capital award

concurrent & approx. 18-24 months

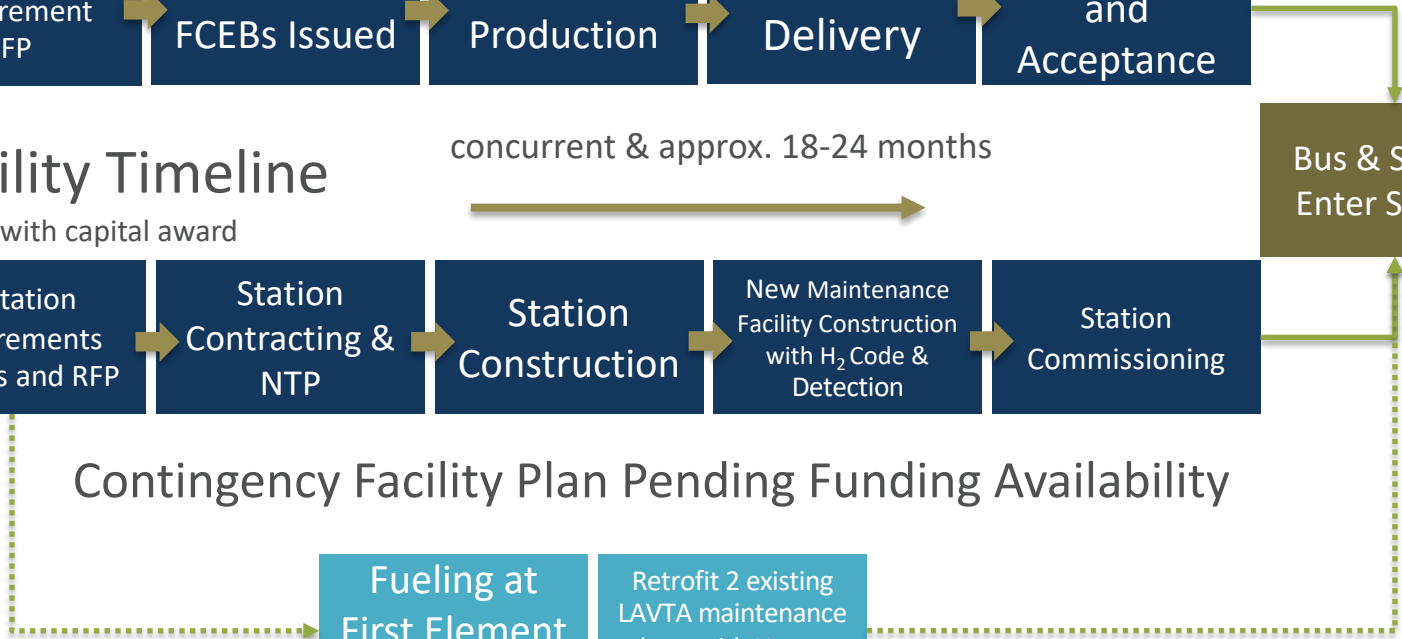


Bus & Station
Enter Service

Contingency Facility Plan Pending Funding Availability

Fueling at
First Element
Distribution

Retrofit 2 existing
LAVTA maintenance
bays with H₂ gas
detection



Station & Maintenance Facility Funding Potential - High



Federal Funding Opportunities

- United States Department of Transportation (USDOT)
 - Better Utilizing Investments to Leverage Development (BUILD) Grant
- 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

State Funding Opportunities

- 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
 - Low Carbon Fuel Standard (LCFS)
- California Transportation Commission (CTC)
 - Solution for Congested Corridor Programs (SCCP)
- California Department of Transportation (Caltrans)
 - Low Carbon Transit Operations Program (LCTOP)
 - State Transit Assistance (STA) + STA SB1
 - Transportation Development Act
 - Transit and Intercity Rail Capital Program
 - Transportation Development Credits
 - New Employment Credit
- California Energy Commission
 - Block Grant for Medium and Heavy Duty Zero-Emission Refueling Infrastructure Incentives
 - EnergIZE

Next Steps

- February 7 – Board of Directors Meeting: Zero-emission transition scenario selection
- **April 4** – Board of Directors Meeting: ICT Rollout Plan Final and Approval by Board

Questions?

