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**

<table>
<thead>
<tr>
<th>Starting January 1</th>
<th>ZEB Percentage of Total New Bus Purchases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2026</td>
<td>25%</td>
</tr>
<tr>
<td>2027</td>
<td>25%</td>
</tr>
<tr>
<td>2028</td>
<td>25%</td>
</tr>
<tr>
<td>2029</td>
<td>100%</td>
</tr>
</tbody>
</table>

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

1. Planning & Initiation
2. Requirements & Data Collection
3. Service Assessment
4. Fleet Assessment
5. Fuel Assessment
6. Maintenance Assessment
7. Facilities Assessment
8. TCO Assessment
9. ZEB Transition Plan
Overnight Depot-Charged BEB Service Feasibility

PERCENTAGE OF BLOCKS THAT ARE ACHIEVABLE

- Original Battery Capacity
- Addendum 2 Battery Capacity

Year: 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040

- 2021: 58%
- 2022: 60%
- 2023: 62%
- 2024: 60%
- 2025: 60%
- 2026: 60%
- 2027: 60%
- 2028: 60%
- 2029: 60%
- 2030: 60%
- 2031: 60%
- 2032: 67%
- 2033: 67%
- 2034: 67%
- 2035: 67%
- 2036: 67%
- 2037: 67%
- 2038: 67%
- 2039: 67%
- 2040: 88%
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

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Total Cost of Ownership</th>
<th>Maintenance</th>
<th>Infrastructure</th>
<th>Fuel</th>
<th>Fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>$138M</td>
<td>$22.1M</td>
<td>$18.5M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEB Only</td>
<td>$201M</td>
<td>$21.7M</td>
<td>$20M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed Fleet</td>
<td>$214M</td>
<td>$22.5M</td>
<td>$15M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FCEB Only</td>
<td>$246M</td>
<td>$24.6M</td>
<td>$8M</td>
<td></td>
<td>$29.7M</td>
</tr>
</tbody>
</table>

Cost of Ownership:
- **Baseline**: $97.7M
- **BEB Only**: $138M
- **Mixed Fleet**: $140.4M
- **FCEB Only**: $151.6M

Cost Breakdown:
- **Maintenance**: 45.7%
- **Infrastructure**: 6.5%
- **Fuel**: 58%
Total Cumulative Costs - Adjusted
BEB VS FCEB, 2021-2040

Total Cost of Ownership (in millions)

- BEB Only:
  - Maintenance: $22.1
  - Infrastructure: $21.7
  - Fuel: $20.0
  - Fleet: $136.9

- FCEB Only:
  - Maintenance: $18.6
  - Infrastructure: $24.6
  - Fuel: $8.0
  - Fleet: $151.6
Staff Recommendation: FCEB

- More flexibility in deployment of fleet
- Higher reliability rate (57% BEB vs 90% FCEB)*
- General consensus is that hydrogen fuel prices will trend lower in next decade, with growing opportunities for green hydrogen. Opportunities to collaborate with Valley Link project.
- Greater chance of fleet deployment following a major disaster.
- Less infrastructure needed at Atlantis and transit centers

* AC Transit ZETBTA report (Part 1)
Hydrogen Transition Timeline

- [LAVTA Roadmap to H2 infographic](#)
Next Steps

• January 10 – Livermore City Council presentation
• January 24 – Project and Services Committee
• 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