Update of Innovative Clean Transit (ICT) Plan

SamTrans Board of Directors
December 6, 2023
2018: California Air Resources Board (CARB) adopted ICT Regulation
• Requires transit providers to transition fleet to 100% Zero Emission (ZE) by 2040
• Requires 100% of fleet purchases to be ZE by 2029

2020: SamTrans ICT Plan approved by Board
• Battery electric buses (BEBs) only
• Includes diesel bus purchases
• Complete ZE transition in 2038
Program Scope

- Vehicle Replacement
- Infrastructure
- Workforce Training
Program Scope

Fixed Route Service

446 square miles
service area

Over 10 million
trips (pre-COVID)

67 Routes/322 Buses
Local | Community |
Express/Limited |
School-oriented | Owl | 
& Special Routes
Program Scope
Paratransit Service

70 Vehicles
To be replaced by ZEVs starting 2026

Shared Ride, Curb-to-Curb Service
Optional door-to-door

Over 344K trips (pre-COVID)
Program Scope

North Base Infrastructure

<table>
<thead>
<tr>
<th>Location</th>
<th>Size</th>
<th>Vehicles</th>
<th>Zero-Emission Infrastructure Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>301 N Access Rd South San Francisco</td>
<td>27 acres</td>
<td>175 buses</td>
<td>10 Interim Chargers commissioned</td>
</tr>
</tbody>
</table>

* Zero emission infrastructure constructed on SamTrans-owned property with no disruption to bus service
Program Scope
South Base Infrastructure

Location
- 501 Pico Boulevard, San Carlos

Size
- 13 acres

Vehicles
- 147 buses

Zero-Emission Infrastructure Status
- 10 Interim Chargers under construction (late 2024)
- 37 Permanent BEB Chargers (late 2026)

* Zero emission infrastructure constructed on SamTrans-owned property with no disruption to bus service
SamTrans is committed to training staff

Program Scope

Workforce Training

Similar job duties/descriptions. New skills!

- Training
- Skills gap assessment
- Re-skilling modules
Zero Emission (ZE) Technology Evaluation

Battery Electric Buses (BEBs)
- Range: 150 – 200 miles
- Charging Time: 4 - 6 hours

Hydrogen Fuel Cell Electric Buses (FCEBs)
- Range: approx. 300 miles
- Fueling Time: 10 - 15 minutes
ZE Technology Evaluation
Fixed Route Service (North Base)

North Base Bus Assignments Distance (Weekday)

- **18** bus assignments beyond BEB range
- **28** bus assignments with range concerns when consumption is high

- **18% - 45%** of bus assignments may have range concerns if only using BEBs
- All bus assignments can be completed by FCEBs

BEB Travel Range:
~150 miles – 200 miles

FCEB Travel Range:
~300 miles

Assumed 40’ bus with 440 kWh, energy consumption at 2.02 kWh/mile – 3 kWh/mile
ZE Technology Evaluation

Fixed Route Service (South Base)

South Base Bus Assignments Distance (Weekday)

- 1 bus assignment beyond BEB range
- 6 bus assignments with range concerns when consumption is high

BEB Travel Range: ~150 miles – 200 miles

FCEB Travel Range: ~300 miles

Assumed 40’ bus with 440 kWh, energy consumption at 2.02 kWh/mile – 3 kWh/mile

- Fewer bus assignments than North Base
- Most bus assignments are shorter than 150 miles
- 1% - 8% of bus assignments may have range concerns if only using BEBs
June 2022: Board approved purchase of 10 FCEBs for North Base as part of a Demonstration Program

May 2023: Board approved purchase of a mobile hydrogen refueler & award of a 2-year hydrogen supply contract for the 10 FCEBs

May 2023: Board approved contract to modify 4 maintenance bays at North Base to enable indoor maintenance of FCEBs
Life-cycle Cost Analysis*

- Performed for North Base Fixed Revenue Fleet
- FCEBs have lower infrastructure costs; BEBs have lower energy costs
- 12-year lifecycle cost savings of FCEB fleet estimated at $94 M

<table>
<thead>
<tr>
<th>Item</th>
<th>BEB Option</th>
<th>FCEB Option</th>
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</thead>
<tbody>
<tr>
<td>Number of Buses</td>
<td>185</td>
<td>162</td>
</tr>
<tr>
<td>Buses</td>
<td>$252,393,157</td>
<td>$247,008,174</td>
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<tr>
<td>Infrastructure</td>
<td>$144,950,000</td>
<td>$36,150,000</td>
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<tr>
<td>Maintenance</td>
<td>$40,492,886</td>
<td>$50,686,882</td>
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<tr>
<td>Energy (Electricity &amp; Hydrogen)</td>
<td>$41,096,703</td>
<td>$51,129,786</td>
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<tr>
<td>Lifecycle Cost Total (NB)</td>
<td>$478,932,746</td>
<td>$384,974,842</td>
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</table>

* Provided at Mar-23 Board Workshop
BEB Infrastructure*

* Provided at Mar-23 Board Workshop
FCEB Infrastructure*

Orange County Transportation Authority
Hydrogen Equipment Compound

* Provided at Mar-23 Board Workshop
FCEBs vs. BEBs

Cost per Bus vs. Fleet Size*

* Provided at Mar-23 Board Workshop
# FCEBs vs. BEBs

## ZE Technology Comparison*

<table>
<thead>
<tr>
<th></th>
<th>Fuel Cell Electric Bus (FCEB)</th>
<th>Battery Electric Bus (BEB)</th>
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<tbody>
<tr>
<td>Market: Number of Manufacturers</td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
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<td>Operations: Advertised Range</td>
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<td></td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>Costs: Maintenance</td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
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<tr>
<td></td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>Facility: Infrastructure</td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
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<tr>
<td>Climate: GHG Reduction</td>
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<td>![Checkmark]</td>
</tr>
</tbody>
</table>

* Provided at Mar-23 Board Workshop
2023 ICT Plan Update*

- Replaces all fixed route vehicles at North Base with FCEBs
- Eliminates diesel bus purchases
- Defers decision for remaining South Base fleet until 2024
- Increases focus on equity and workforce development
- Completes zero emission transition in 2034

* Aligns with Recommendations at Mar-23 Board Workshop
2023 ICT Plan

Fleet Procurement Plan

<table>
<thead>
<tr>
<th>FCEBs (No. Base)</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>2031</th>
<th>2032</th>
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<tr>
<td></td>
<td>0</td>
<td>10</td>
<td>20</td>
<td>88</td>
<td>26</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<table>
<thead>
<tr>
<th>BEBs (So. Base)</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>2031</th>
<th>2032</th>
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<tbody>
<tr>
<td></td>
<td>7</td>
<td>30</td>
<td>0</td>
<td></td>
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<table>
<thead>
<tr>
<th>ZEBs (So. Base)</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>2031</th>
<th>2032</th>
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<tbody>
<tr>
<td></td>
<td>0</td>
<td>36</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
</tbody>
</table>

|                  | 7    | 40   | 20   | 88   | 62   | 0    | 0    | 0    | 50   | 0    | 0    | 55    |

* Defer decision on type of ZEB for remaining So. Base fleet until 2024
2023 ICT Plan

Fleet Replacement Plan

- **2023**: 6% ZEB
- **2026**: 48% ZEB
- **2034**: 100% ZEB

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**Table:**

<table>
<thead>
<tr>
<th>Year</th>
<th>DIESEL</th>
<th>FCEB</th>
<th>BEB</th>
<th>ZEB (TBD)</th>
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<tr>
<td>2022</td>
<td>297</td>
<td>0</td>
<td>0</td>
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<tr>
<td>2023</td>
<td>292</td>
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<td>2031</td>
<td>86</td>
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<td>175</td>
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<tr>
<td>2032</td>
<td>86</td>
<td>55</td>
<td>144</td>
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</tr>
<tr>
<td>2033</td>
<td>86</td>
<td>55</td>
<td>144</td>
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<tr>
<td>2034</td>
<td>110</td>
<td>37</td>
<td>144</td>
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</tbody>
</table>

**Notes:**
- DIESEL, FCEB, BEB, ZEB (TBD) represent different types of fleet vehicles.
- ZEB refers to Zero-Emission Buses.
- The percentages indicate the proportion of ZEB in the fleet each year.
2023 ICT Plan
Infrastructure

- Hydrogen Storage & Fueling Station at North Base
- Additional Modifications to North Base Maintenance Building
- Additional Permanent BEB Chargers and/or Hydrogen Fueling Station at South Base, depending on decision for remaining fleet
SamTrans Facility Locations
San Mateo County
Add materials to strengthen soil

Install deep foundations to reduce settlement potential

Place ground improvements beyond the building’s footprint to confine soil

Engage an independent third-party geotechnical engineer to review foundation design
2023 ICT Plan
Equity Analysis

Equity Priority Areas

- Low-income households
- Racial and ethnic minorities
- Zero-car households

Goal: Prioritize service in Equity Priority Areas
## 2023 ICT Plan
### Cost Estimates & Funding

<table>
<thead>
<tr>
<th>Item</th>
<th>Year of Expenditure</th>
<th>Estimate (in $M)</th>
<th>Grants and Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Zero Emission Buses (ZEBs)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FCEBs FY24</td>
<td>$162.3</td>
<td>$123.9M (FTA &amp; State grants) + HVIP(^2) + ARCHES(^3)</td>
<td></td>
</tr>
<tr>
<td>FCEBs FY25 - FY32</td>
<td>$135.3</td>
<td>FTA (50% - 55% of Cost) + State Incentives</td>
<td></td>
</tr>
<tr>
<td>ZEBs (TBD)(^1) FY25 - FY32</td>
<td>$198.4</td>
<td>FTA (50% - 55% of Cost) + State Incentives</td>
<td></td>
</tr>
<tr>
<td>Paratransit FY25 - FY32</td>
<td>$35.0</td>
<td>FTA (50% - 55% of Cost) + State Incentives</td>
<td></td>
</tr>
<tr>
<td><strong>Total - ZEBs</strong></td>
<td>$531.0</td>
<td></td>
<td></td>
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<tr>
<td><strong>ZEB Infrastructure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. Base - FCEB FY24 - FY26</td>
<td>$36.2</td>
<td>ARCHES(^3) Grant (amount pending)</td>
<td></td>
</tr>
<tr>
<td>So. Base - BEB FY24 - FY27</td>
<td>$37.5</td>
<td>$28.12M in Federal &amp; State grants</td>
<td></td>
</tr>
<tr>
<td>So. Base - ZEB (TBD)(^1) FY26 - FY31</td>
<td>$93.6</td>
<td>Apply for Competitive Grants</td>
<td></td>
</tr>
<tr>
<td><strong>Total - ZEB Infrastructure</strong></td>
<td>$167.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Cost Estimates assume remaining ZEBs are BEBs  
\(^2\) HVIP - CA Hybrid & Zero Emission Truck & Bus Voucher Incentives  
\(^3\) ARCHES - Alliance for Renewable Clean Hydrogen Energy Systems (D.O.E. Hydrogen Hub Grant Recipient)
2023 ICT Plan
Considerations & Challenges

- Significant Supply Chain & Production Delays
- BEB Market Fluctuations & Limited FCEB Options
- New Protocols for Emergency, Safety, and Resiliency Management
- Material Sourcing & End-of-Life Sustainability
2023 ICT Plan
Ongoing Efforts

- BEB & FCEB Real-World Data Collection
- Continued Monitoring of the Market
- Funding Applications

100% ZE Fleet

- Sea Level Rise Mitigation
- Periodic Review of Plan
- ICT Regulation Annual Fleet Update
- Facility Upgrades and Vehicle Procurements
Progress
Progress

17 BEBs delivered to No. Base
14 BEBs in revenue service
Progress

1 FCEB delivered to North Base
Progress
BEB Infrastructure

10 Depot Chargers at North Base

Construction of 10 Depot Chargers at South Base
Mobile Hydrogen Refueler to be delivered to North Base
NEXT STEPS

- Seek Board Approval for Purchase of up to 108 FCEBs
- Submit Updated ICT Plan to California Air Resources Board