Development of Zero Emission Bus Technology in the Bay Area: Regional Progress and Technological Promise

California Air Resources Board
Zero Emission Bus Workshop
June 21, 2006

The San Francisco Bay Area Transit System

4 Multi-modal Systems

- San Francisco Muni
  - Light rail, Cable car, Street car, Electric Trolley, Motor coach, Paratransit
- Santa Clara Valley Transit Authority
  - Light rail, Bus, Paratransit
- Golden Gate Bridge, Highway, and Transportation District
  - Bus, Ferry, Paratransit
- City of Vallejo
  - Bus, Ferry, Paratransit

The San Francisco Bay Area Transit System

3 Commuter Rail Systems

- Bay Area Rapid Transit (BART)
- Caltrain
- Altamont Commuter Express (ACE Train)

The San Francisco Bay Area Transit System

12 Bus Systems

- Alameda Contra Costa Transit (AC Transit)
- Central Contra Costs Transit Authority (County Connection)
- East Contra Costa Transit Authority (Tri-Delta)
- Fairfield-Suisun Transit
- Livermore-Amador Valley Transit Authority (Wheels)
- Napa Transit Services (VINE and VanGo)
- San Mateo County Transit District (SamTrans)
- Santa Rosa City Bus
- Sonoma County Transit
- Union City Transit
- Vacaville Transit
- Western Contra Costa Transit Authority (WestCAT)

The San Francisco Bay Area Transit System

FY 2004-05 Operating Statistics

- 477 Million Total Passengers
- 185 Million Revenue Vehicle Miles
- 12.3 Million Revenue Vehicle Hours
- 13,500 Employee Equivalents (FTE – excluding paratransit)

MTC's Statistical Summary of Bay Area Transit Operations, January 2006 Revised

METROPOLITAN TRANSPORTATION COMMISSION

The San Francisco Bay Area Transit System

$311 Million in Regional Clean Air Investments

- Cleaire Devices - $34 Million
- Spare the Air Free Transit -$12 Million
- Diesel Electric Hybrid Buses - $144 Million
- CARB Associated Emission Reductions - $121 Million
  - 410 Tons Annual NO_X Reduction
  - 93 Tons Annual PM Reduction
  - Two (3 Bus) Zero Emission Bus Demonstrations

METROPOLITAN TRANSPORTATION COMMISSION

Zero Emission Bus Demonstrations

VTA-SamTrans

- 3 Hydrogen Fuel Cell Buses
- New fueling facility
- New maintenance facility
- Price tag: $15 Million
- Funding sources: federal earmark/local sales tax measure

Zero Emission Bus Demonstrations

AC Transit-GGBHTD

- 3 Hydrogen Fuel Cell Hybrid Buses; Fourth Operated by Sunline in Palm Springs
- Two Fueling Facilities; Third Planned
- Modifications to Maintenance Facility
- Price tag: $18 Million
- Funding sources – federal earmark/local measure funds

Zero Emission Bus Demonstrations

What have we learned so far?

- Bay Area regional Partnership is committed to furthering fuel cell technology
- Public transit demonstration projects can drive development of zero emission technology given adequate time and funding
- Evaluation data enables manufacturers to increase reliability, expand supply and reduce costs
- Regional cooperation on demonstration projects is a viable model for larger scale implementation

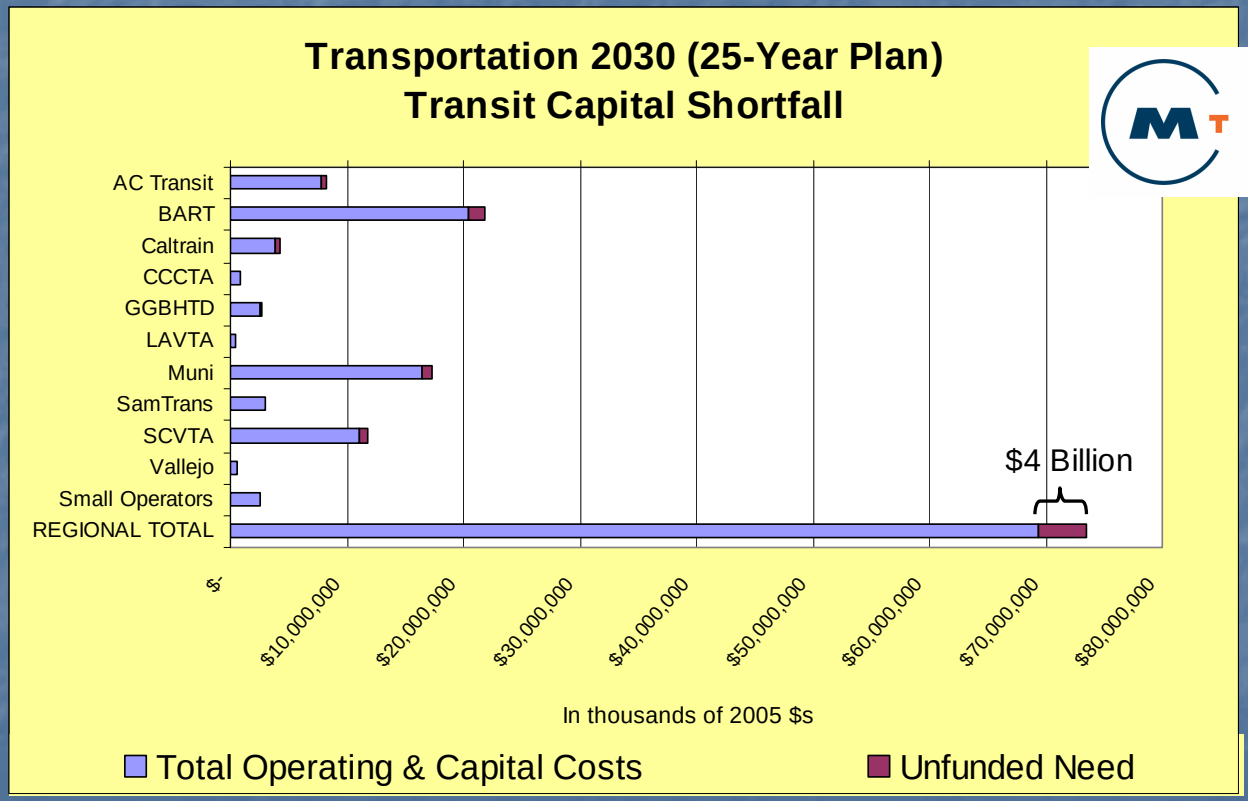
Zero Emission Bus Demonstrations

What have we learned so far?

- Fuel cell hybrid technology is promising but not ready for commercial or public transit implementation
  - Evaluation of performance, reliability and durability is not yet complete – reliability is critical for public transit
  - Capital and operating costs need to come down before large scale implementation is feasible – current ZEBs cost ~10X diesel buses, fuel costs ~4X diesel
  - Limited federal and state funding constrains development of technology – only $49 million nationwide during SAFETEA
  - Limited manufacturing capacity unlikely to meet demand created by purchase requirement

San Francisco Bay Area Transit System
25 Year Transit Capital Funding Challenges

Region currently projects $4.1 billion transit capital shortfall without ZEB demonstration or infrastructure costs

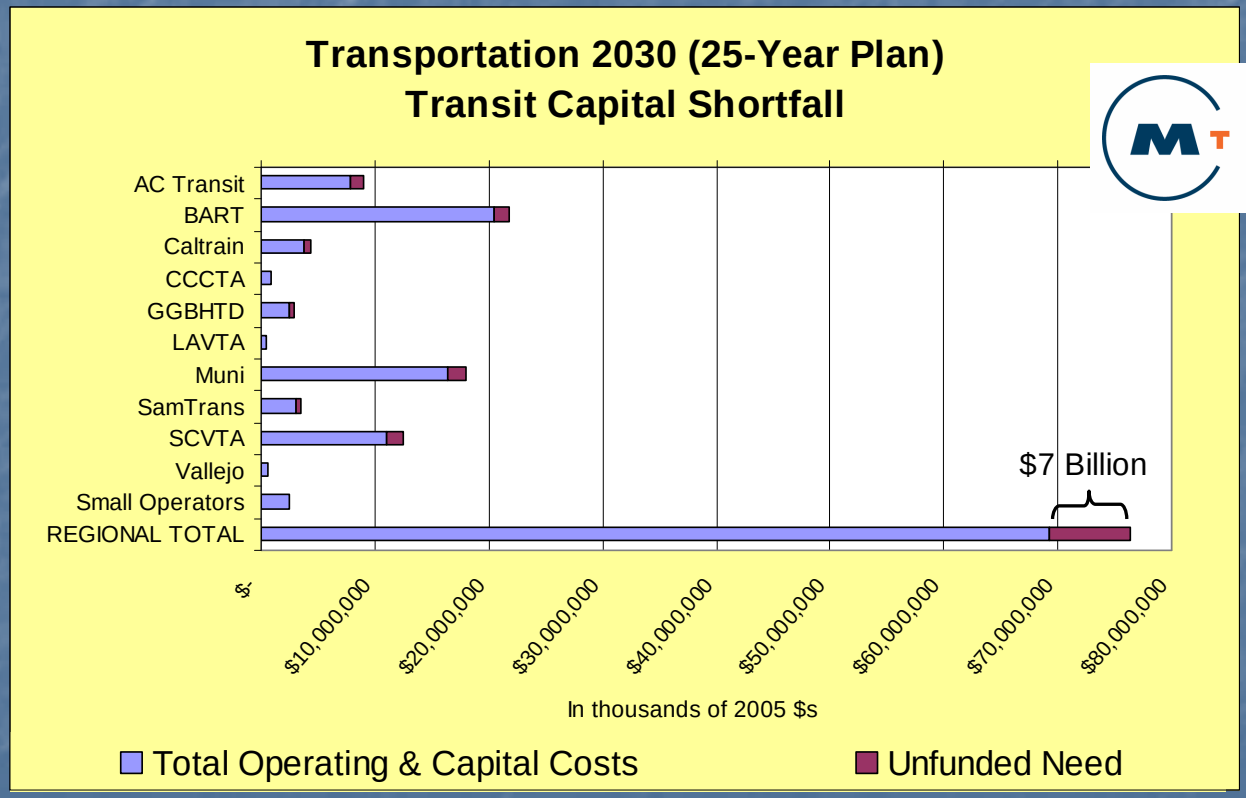


METROPOLITAN TRANSPORTATION COMMISSION

Average Bus Costs Modeled at $517,000

San Francisco Bay Area Transit System
25 Year Transit Capital Funding Challenges

Implementation of ZEBs in regional fleet could drive shortfall up to $7 Billion plus costs of demonstration and infrastructure



Average Bus Costs Modeled at $2.3 Million per bus + 2 fuel cell replacements over 12 year life of vehicle at $1 million per fuel cell - Total Bus Cost $4.3 million. Assumes 15% purchase requirement continues through 25-year planning period.

San Francisco Bay Area Transit System 25 Year Transit Capital Funding Challenges

What impact would a larger shortfall have on the region's transit system?

- Shortfalls force transit properties to make choices between cutting service and deferring maintenance
- If service is cut,
  - More people drive, causing greater congestion and air pollution
  - Mobility options are reduced for transit-dependent people
- Deferred maintenance reduces reliability, pushing people back into their cars

Bay Area Proposal for Revisions to CARB's Zero Emission Bus Requirements

- Expanded Regional ZEB Demonstration
  - Build on lessons learned from first-stage demonstrations to reach next threshold of development of commercially viable fuel cell technology
  - Testing under wider variety of operating parameters provides more complete data, leading to better next-generation products at reduced costs
  - Expand ZEB operations to additional Bay Area operators
- ZEB Implementation – Making Progress Affordable
  - Maintain 15% purchase requirement
  - Shift implementation date to 2014 to allow time for development of technology and manufacturing capacity

Bay Area Proposal for Revisions to CARB's Zero Emission Bus Requirements

Expanded Regional ZEB Demonstration

- Phase I: Accelerated testing
  - Expand bus operating hours to provide data for technology improvements
- Phase II: Bus Upgrades
  - Update technology in existing ZEBs for longer fuel cell life and lower costs
- Phase III: Fleet Expansion
  - Expand existing ZEB fleet by 7 buses for a total of 10
  - <u>If technological advances permit and funding is available</u>, expand fleet by up to 17 new buses for a total of 20
  - Expand ZEB infrastructure to support additional buses

Bay Area Proposal for Revisions to CARB's Zero Emission Bus Requirements

Expanded Regional ZEB Demonstration

- Build on region's experience with current demos
- Current partnerships provide models for regional planning and oversight of project
  - Regional ZEB working group already formed
  - Region working to identify matching funds for federal grants
- Regional operation of expanded demonstration fleet
  - Operating plan to be developed by ZEB working group to optimize technology development and cost-effective use of infrastructure
  - Operations and maintenance training program for other operators by AC Transit and VTA to enable regional operators to use demo buses and prepare for ZEB implementation
  - Leverage existing resources by using AC Transit and VTA fueling and maintenance infrastructure

Bay Area Proposal for Revisions to CARB's Zero Emission Bus Requirements

ZEB Implementation – Making Progress Affordable

- Shifting ZEB implementation to 2014 will allow:
  - Expanded regional demonstration to be completed, supporting development of next, more reliable generation of ZEB technology to provide better service to the public
  - Transit operators to develop infrastructure and experience needed to operate ZEBs on fleet scale
  - Manufacturing capacity to expand to meet higher demand created by purchasing requirement
  - Costs – capital and operating – to come down to affordable levels, reducing need to cut services or defer maintenance