

Update on the Status of the Advanced Clean Transit Rule

February 18, 2016

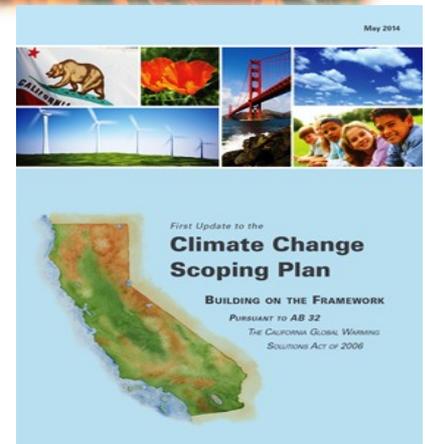
California Environmental Protection Agency

Air Resources Board



Driving Change

- * Significant reductions needed to meet air quality and climate goals:
 - * Meet federal health-based ambient air quality standards
 - * 40% reduction in GHGs by 2030
 - * 80% reduction in GHGs by 2050
 - * Up to 50% petroleum use reduction by 2030
- * Achieving goals will require a transformational change



Long-term Transformation for Mobile Sources

“Zero emission equipment everywhere feasible, and near-zero emission equipment powered by clean low-carbon renewable fuels everywhere else.”

--Sustainable Freight: Pathways to Zero and Near-Zero Emissions
(Discussion Draft, April 2015)



Transit Agency Mission

- * Provide safe, reliable and affordable public transit service, including in disadvantaged communities
- * Help meet future population growth needs
- * Reduce traffic congestion, urban parking, and local air quality issues
- * Help achieve climate goals
- * Promote better land use
- * Provide emergency transportation

Transit Operations Vary

- * Transit operators differ throughout the state
 - * Great diversity in size, type, mission, scope, ridership
 - * Urban, suburban and rural systems
 - * Challenging to make one rule that fits all well
- * Transit agency governance is also varied
 - * Some are municipal departments, others are independent with Boards of Directors
- * Budgets are based on income from several sources

Existing Transit Fleet Rule

- * Initially adopted in 2000; transit fleets first to transition to alternative fuels or diesel particulate filters
- * Significant reductions in diesel PM and NOx emissions from transit fleets
- * Two fuel paths: diesel path or alternative-fuel path
- * Includes long-term zero emission bus purchase requirement
 - * Purchase requirement on hold pending bus technology assessment (Resolution 09-49)

Technology Assessment

- * Update in November 2015
- * Both battery and fuel cell electric buses are commercially available for transit applications
- * Significant technology advancements since 2009
 - * Increased reliability & availability
 - * Declining costs
 - * Improved performance
 - * Extended mileage range



Vision for Future Transit

- * Use most efficient transportation technologies
- * Enhanced service for disadvantaged communities
- * Seamless integration between modes and transit systems
- * Enhanced mobility with innovation
- * Continue to provide efficient, safe, and affordable transit services across California

Advanced Clean Transit Concept

- * Mix of cleaner combustion & zero-emission buses
 - * Transition to zero-emission buses by 2040
 - * Low NOx technologies; use of renewable fuels
- * Natural fleet replacement rate (not accelerated)
- * Flexibility for regional collaboration and opportunity for greater efficiencies in transporting passengers

Questions from Transit Agencies

- * Can the technology meet range and reliability needs?
- * How to handle the potential higher capital costs in both vehicle and infrastructure
- * Will there be a potential reduction in transit service?
- * Other questions raised at October Board Hearing
 - * Should a performance-based approach be considered (e.g. low NOx engine + renewable fuels as an option)?
 - * Can more communication channels be provided?

Near-Zero Emission Bus



Low NOx engines

- First CNG engine 90% lower NOx commercially available in spring 2016
- Diesel engines not yet available

Renewable Fuels

- GHG benefit (LCFS)
- Long-term supply issue

Zero-Emission Fuel Cell Electric Bus



- AC Transit, Sunline Transit
- Excellent range, improved durability
- Fueling time comparable to diesel fueling
- Hydrogen price is comparable to fossil fuels with large throughput
- Still costly at low volumes

Zero-Emissions Battery Electric Bus (Slow Charge)



- Antelope Valley Transit, LA Metro, Long Beach Transit, and Santa Barbara MTD
- Up to 160 miles per charge
- Charging infrastructure is inexpensive (3-4 hours)
- Fuel cost savings
- Not restricted to a designated route
- Range constraint

Zero-Emissions Battery Electric Bus (Fast Charge)

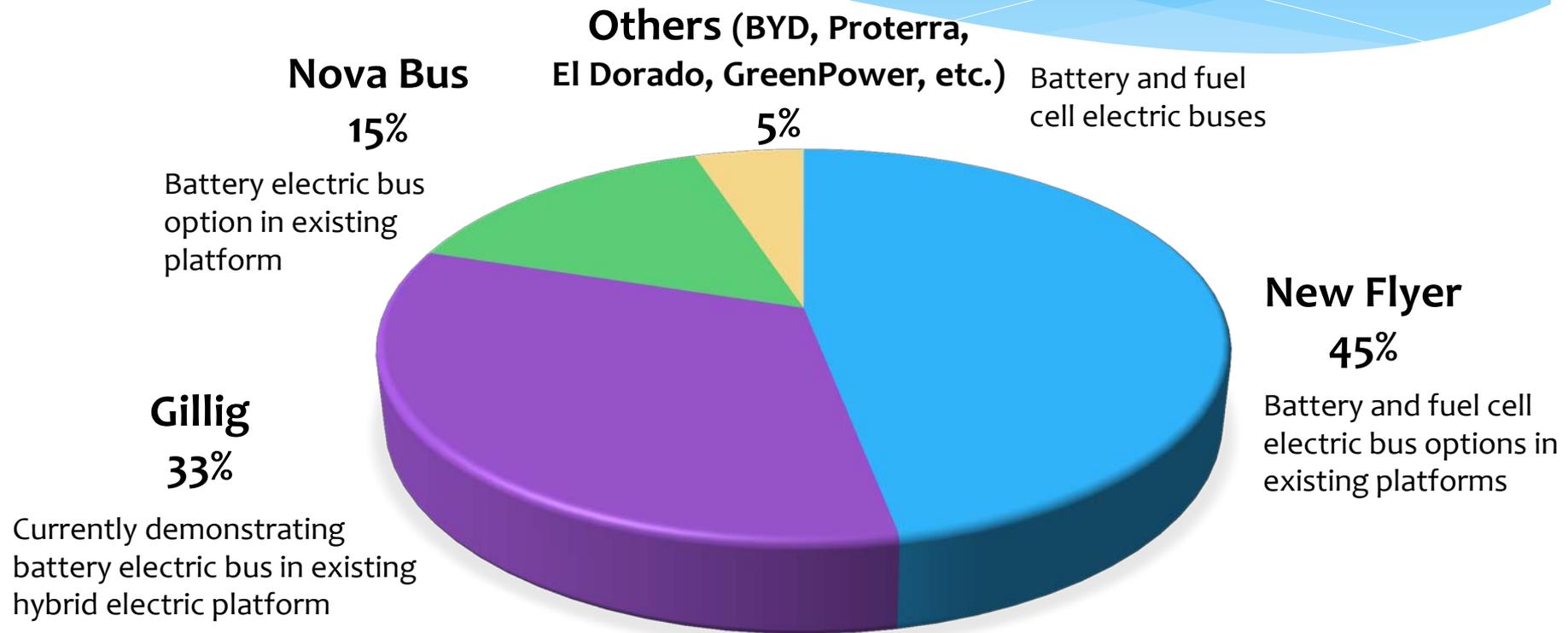


- San Joaquin RTD, Foothill Transit
- On-route fast charging (3-10 min) = unlimited range
- Charging infrastructure is more expensive
- Fixed routes
- Off-street charging is more desirable

Zero Emission Bus Market Ready to Expand

- * Ten California fleets operating zero emission buses
 - * Several fleets adding zero emission buses this year
- * Number of zero emission buses to more than double in California this year
- * Ten bus manufacturers offering dozens of models in various bus categories and sizes
- * Five zero emission bus manufacturing facilities in California
- * United States and world market expanding

Nearly all Bus Manufacturers Offer Zero Emission Buses



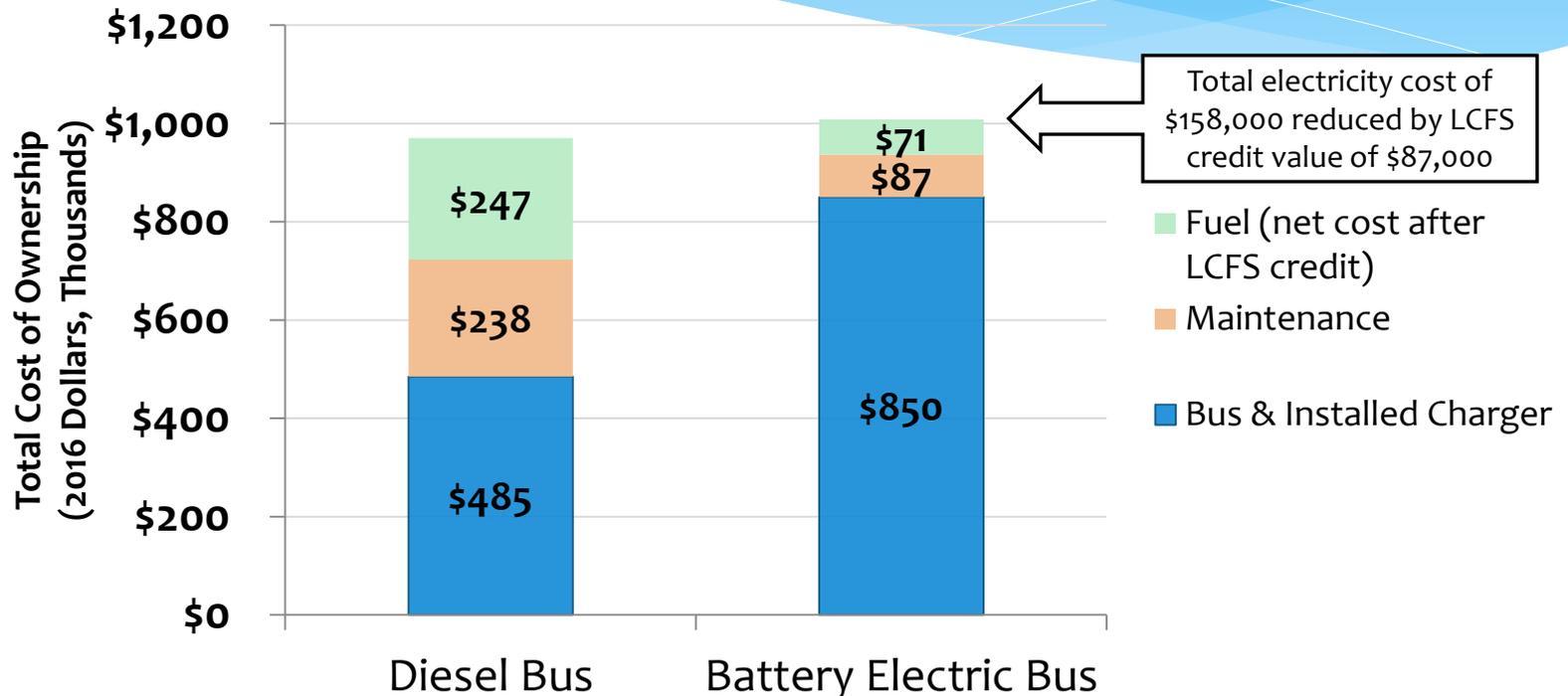
Source: New Flyer, 2014

U.S. Transit Bus Market Share

How Do Costs Compare?

- * Some prices already comparable to conventional hybrids
- * Potential battery electric bus cost savings
 - * Maintenance cost saving
 - * Fuel cost saving
 - * Highly variable electricity rates
- * Fuel cell electric bus costs are declining but are still high in low volumes
- * Other start-up costs with transition to new technology
- * Continuing to refine cost details and collect data

Total Cost of Ownership in the Same Ballpark



Note: Analysis period is 14 years at 40,000 miles/year for both buses and future costs adjusted to 2016 dollars.

Diesel Bus

- 4 miles/gal on at \$2.50/gallon
- Maintenance is \$0.60/mile
- LCFS credit is typically received by fuel provider and already reflected in price when renewable diesel is used

Battery Electric Bus

- 2 kWh/mile at \$0.2/kWh
- Maintenance is \$0.22/mile
- LCFS credit value of \$100 (claimed by transit agency)
- 12 year battery warranty

Advanced Technology Funding

Provider	Program
Bus Manufacturers	Battery leasing and other financing options
Air Resources Board	<ul style="list-style-type: none">• Low Carbon Fuel Standard program• Zero-Emission Bus Pilot Commercial Deployment Project• Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)
California State Transportation Agency (CalSTA)	The Transit and Intercity Rail Capital Program
Caltrans	The Low Carbon Transit Operations Program
Federal Transit Administration	Low or No Emission Vehicle Deployment Program

Meeting Service Needs

- * No reduced transit service as a result of the regulation
- * Learning from transit fleets operating battery electric and fuel cell electric buses in revenue service
- * Phased-in schedule to reduce operational risk and maximize the useful life of existing infrastructure
- * Large deployments possible
 - * Antelope Valley Transit already committed to 100% battery electric bus fleet by end of 2018
- * Technology off-ramps to address operational concerns

Supporting Disadvantaged Communities

- * Many transit systems operate in congested and disadvantaged areas
 - * Localized pollution can be a problem
- * Priority for investments in disadvantaged communities
- * Priority to maximize emission reductions while improving transit service



Considerations for a Performance-Based Approach

- * NO_x/PM emissions in non-attainment areas
- * Life cycle GHG emissions
- * Surplus emission benefits outside of other regulatory programs
- * Availability and best use of renewable fuels
- * Impact of deterioration and high-emitters

Established Workgroups and Enhanced Outreach

- * Advanced Clean Transit Workgroup
 - * Transit Agency Subcommittee
- * Technology Symposium
- * Board members and staff visiting transit agencies to better understand experiences and concerns

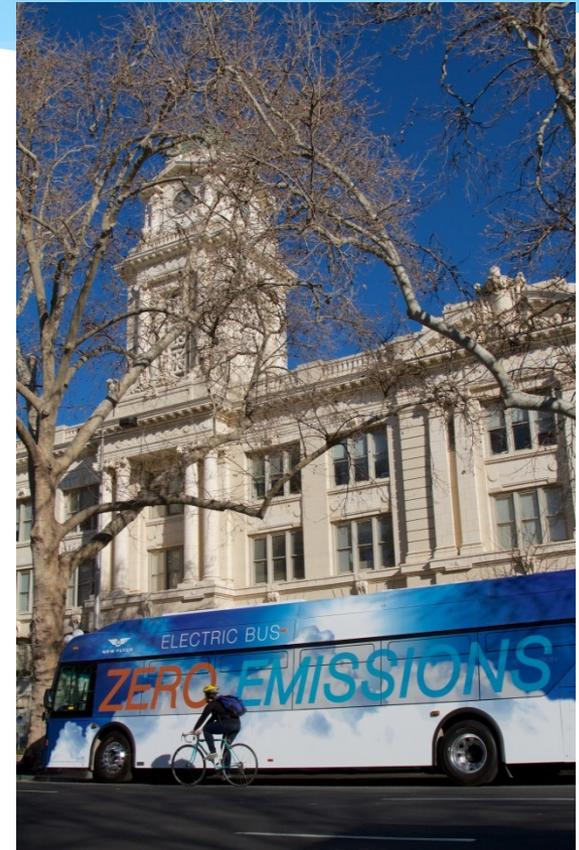


Advanced Clean Transit Workgroup and Transit Agency Subcommittee

- * Consensus on cost methodology
 - * Are collecting more data for analysis
- * Collecting information about individual transit fleet operations
- * Discussing alternative compliance plans and options
 - * Concepts for a performance based framework
 - * Enhanced mobility options (car/bicycle sharing)
- * Discussing potential technology off-ramps

Technology Symposium

- * Several transit agencies incorporating zero emission buses in regular service
- * Charging standardization progress
- * First low NOx CNG engine soon to be commercial
- * Opportunities to integrate different fuels and energy management strategies
- * Transit agencies beginning to recognize LCFS benefits



Next Steps

- * Continued engagement with stakeholders
 - * Advanced Clean Transit Workgroup
 - * Transit Agency Subcommittee
 - * Refine cost numbers and operational needs
- * Additional outreach and education
- * Workshops in spring and summer 2016
 - * Technology and regulatory proposals
 - * Economics and business case, funding and incentives
- * Board consideration late 2016