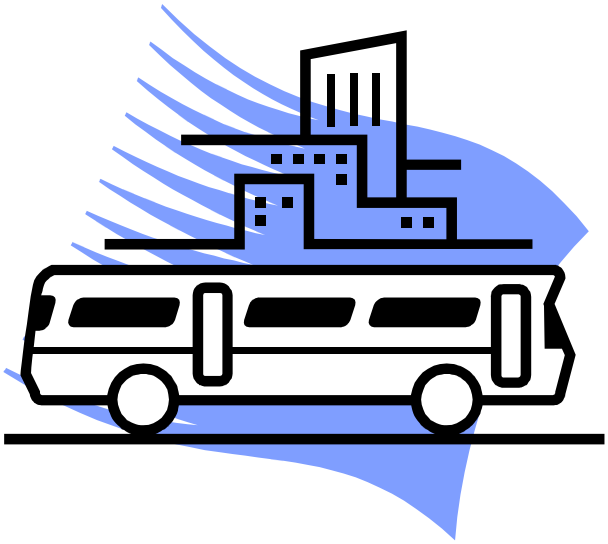
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

PROPOSED AMENDMENTS TO THE ZERO EMISSION BUS REGULATIONS



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I EXECUTIVE SUMMARY

Air quality in California has improved dramatically over the past 30 years, due in large part to the continued progress in controlling pollution from mobile sources. Despite the achievements to date, the vast majority of Californians live in areas of the state that still do not meet State or federal health-based ambient air quality standards.

In February 2000 the Board confirmed its continued commitment toward improving emissions from public transportation by establishing a new fleet rule for transit agencies and more stringent emission standards for new urban bus engines and vehicles. The rule also promoted advanced technologies by adopting zero emission bus (ZBus) demonstration and ZBus acquisition requirements for larger transit agencies[1]. The focus of this proposal is the ZBus section of the regulation.

Based on demonstrated performance, expected cost and availability, transit agencies viewed the fuel cell engine as the transportation industry's environmental solution and eagerly initiated efforts to further test and evaluate fuel cell buses. In addition, at the time the transit bus regulation was developed, information available to staff indicated that the research and development of fuel cells would result in their market application in transit buses before their application in light duty vehicles. However, that has changed, and more recently manufacturers have focused their efforts primarily on developing light duty vehicle fuel cell applications instead of bus applications.

In June 2004, staff brought amendments to the ZBus requirement to the Board. Staff proposed amendments to the ZBus program to conform to the market conditions and availability of ZBuses. The Board revised the zero emission bus demonstration program by reducing the number of concurrent fuel cell buses and extending the time period for initiation and completion of the demonstration projects[2]. Despite the efforts of the technology providers and transit agencies, ZBus technology has not developed as rapidly as initially projected and staff proposes additional amendments.

A Proposed Requirements

In February 2000, the Board established a new fleet rule for transit agencies which included the zero emission bus (ZBus) regulation. Each transit agency was required to select a compliance path – either the "diesel" path or the "alternative fuel" path. The path selection set the fuel type for new urban bus acquisitions through model year 2015. Transit agencies, on either path, were required to achieve fleet reduction requirements for emissions. The zero emission bus portion of the rule promoted advanced technologies by requiring a demonstration and a fifteen percent acquisition or purchase requirement[1]. The diesel path agencies were required to conduct the initial ZBus demonstrations with acquisition requirements starting in 2008. Since the alternative fuel path required new infrastructure, such as high pressure natural gas tanks, alternative fuel path transit agencies were exempt from the initial demonstration. In addition, the

[1] ARB. February 24, 2000. Resolution 00-2.
[2] ARB. June 24, 2004. Resolution 04-19.

purchase requirement commenced in 2010, a two year delay from those transit agencies on the diesel path.

Staff is proposing that the fifteen percent purchase requirement be postponed by three years for transit agencies on the diesel path, and one to two years for transit agencies on the alternative fuel path. To ensure continued development of ZBus technology and offset some of the emission losses, staff is proposing an Advanced Demonstration requirement. The start date of the Advanced Demonstration depends on the fueling path of the transit agency: diesel path agencies would start January 1, 2009 and the alternative fuel path agencies would begin on January 1, 2010. Staff proposes that the Advanced Demonstration be optional for those transit agencies on the alternative fuel path. All diesel path agencies and those alternative fuel path transit agencies not participating in the Advanced Demonstration would start the purchase requirement on January 1, 2011. Alternative fuel path transit agencies that opt into the Advanced Demonstration would be given an additional year, January 1, 2012, for the start of the purchase requirement.

Staff believes the Advanced Demonstration will provide valuable information on the integration of zero emission buses within the regular fleet. The purpose of the advanced demonstration is to give the transit agencies' maintenance personnel and operators experience with a larger fleet of zero emission buses, and allow the transit agencies to develop or expand experience with hydrogen. Since the purchase requirement will be delayed in all scenarios, staff proposes to extend the purchase requirement from 2015 to model year 2026.

An Advanced Demonstration by a single transit agency would require purchase and demonstration of a minimum of six ZBuses. Or, several agencies may join together to form a multi-transit agency Advanced Demonstration. The multi-transit agency demonstration requires a minimum of twelve buses overall, with each agency purchasing a minimum of three ZBuses. For example, a demonstration with five transit agencies participating would require 15 ZBuses since each transit agency needs to purchase a minimum of three buses.

B Environmental and Economic Impacts

The proposed amendments will delay emission reductions in the 2015 time frame as presented on Table I-1. These emission estimates are based on Scenario 1, where the purchase requirement is delayed until 2011 and alternative fuel path transit agencies opt to not participate in the Advanced Demonstration and align their purchase requirements with the diesel path transit agencies in 2011. There is no way to recoup these reductions since ZBuses represent the cleanest available technology and there is no substitute technology that achieves the same benefit.

Table I-1: Impacts on Emissions from Proposed Regulation through 2015 (Tons Per Year)

	Oxides of Nitrogen (NOx)	Particulate Matter (PM)	Carbon Monoxide (CO)	Hydrocarbons (HC)
2010	(2.15)	(0.081)	(2.21)	(0.053)
2015	(2.21)	(0.084)	(2.29)	(0.055)

The existing regulation is expensive and, if not amended, would severely impact transit agency operations and their ability to adequately serve the public. The current cost of the hydrogen fuel cell buses is estimated to be about $2.25 million per bus[3]. To meet the 15 percent purchase requirement imposed by the existing regulation in 2008, transit agencies would be paying over five times the cost of a conventional bus. Bus cost estimates are not indicative of the actual direct cost to transit agencies. Transit agencies typically receive federal and regional funds for the acquisition of buses and implementing alternative fuel infrastructure. The Federal Transit Administration funds 80-percent of the cost of a diesel bus and 90-percent of the incremental cost of an alternatively fueled bus. However, federal funds are limited and the current cost of available technology makes successful implementation of the existing regulation infeasible.

Since transit agencies have a fixed budget to work with, compliance with the existing regulation may cause them to reduce the total number of buses purchased to afford the fuel cell buses. Reducing the total number of new buses purchased means leaving older and dirtier buses on the road longer or a reducing transit service due to the fleet reduction.

By delaying the 15 percent purchase requirement, staff estimates that the revisions will result in a total cost savings of $59 million to the transit agencies, state agencies, and federal government from 2008 through 2011. After 201, the estimated cost for all transit agencies affected by the proposed regulation, of acquiring zero emission buses, is about $32 - $58 million per year. Conversely, the proposed regulatory changes may have a negative fiscal impact on fuel cell manufacturers because they will delay their return on investment.

Based on costs presented by fuel cell, chassis, system integrators and transit operators, staff determined that, at least for the early years of the program, the dollars spent per ton of pollutant reduced under the ZBus program will be much higher than for typical ARB regulatory measures. However, these costs will decrease as the production volume increases. With production volumes at around 100 buses, the cost of the next

[3] Michael Tosca, Senior Product Manager, Fleet Products, UTC Fuel Cells. 08/08/06

generation fuel cell bus is estimated to be around $1 million[4]. From these costs staff has calculated cost effectiveness to be about $380 per pound of oxides of nitrogen reduced. Staff anticipates the actual cost per pound to be lower, since this cost does not include life-cycle cost savings. This value also does not include funding received from any government funding sources, such as the Federal Transit Administration.

Although the initial purchase costs may still be higher than conventional diesel and alternative fuel bus technology, the price is comparable to an electric trolley bus. Also, as technology is optimized, fuel cell bus operation and maintenance costs are estimated to be in line with electric trolley buses, and significantly lower than diesel and alternative fuel buses. When incorporating these factors along with additional improvements to fuel cell technology, staff anticipates that life cycle costs will decrease the cost per pound of emission reduced. This regulation provides a necessary avenue to bring this technology to the market. In addition, the Board has confirmed in previous regulatory decisions, zero emission vehicle programs are an essential component of the State's long-term air-quality strategy.

C Regulatory Authority

The proposed amendments, as described herein, are consistent with the authority of the ARB to control emissions from mobile sources. To maintain current emission reduction goals set for transit buses in 2000[1], the ARB staff recommends that the Board adopt the proposed amendments to sections 2023.1, 2023.3 and 2023.4, title 13, California Code of Regulations, set forth in the proposed Regulation Order in Appendix A.

D Staff Recommendation

The ARB staff recommends that the Board adopt the amendments as set forth in the proposed Regulation Order in Appendix A and as described in this Initial Statement of Reasons.

[4] Michael Tosca, Senior Product Manager, Fleet Products, UTC Fuel Cells. "H2 Fuel Cell Buses For California". Presented to ARB Staff during 06/21/06 workshop meeting.

II INTRODUCTION

The goal of the Air Resources Board (ARB or "the Board") is to provide clean, healthful air to the citizens of California. California's commitment to providing clean public transportation is an important part of achieving this goal. Public transportation has important societal benefits, including providing access to work and education, reducing traffic congestion, and meeting the mobility needs of the public, including the elderly and physically challenged.

Most types of public transportation, however, are also sources of engine exhaust emissions of oxides of nitrogen (NOx) and hydrocarbons (HC) which contribute to the atmospheric formation of ozone and fine particulate matter (PM). Diesel PM is identified as a toxic air contaminant – a cancer-causing pollutant that also has significant short- and long-term negative respiratory and cardiovascular impacts. These emissions often occur within California's most populated areas. It is, therefore, vital to all Californians that the ARB continue its efforts to reduce engine exhaust emissions from all sources, including transit buses, which are the subject of this rulemaking.

In February 2000, the Board confirmed its continued commitment toward improving emissions from public transportation by establishing a new fleet rule for transit agencies which included the zero emission bus (ZBus) regulation. Each transit agency was required to select a compliance path – either the "diesel" path or the "alternative fuel" path – by January 1, 2001. Path selection set the fuel type for new urban bus acquisitions through model year 2015. Transit agencies, on either path, were required to achieve fleet reduction requirements for NOx and PM emissions. The zero emission bus portion of the rule promoted advanced technologies by adopting ZBus demonstrations, applicable to diesel path agencies, and ZBus acquisition requirements applicable to transit agencies on both fuel paths[1].

Recognizing the long term nature of the regulations, the Board required staff to report back regularly on implementation progress. Staff worked closely with transit agencies to encourage compliance and reported back to the Board at its September 20, 2001, and March 21, 2002, public meetings. ARB staff had closely monitored activities related to ZBus demonstrations and it was clear that while demonstrations were significantly behind schedule, the delay was a consequence of conditions out of the transit agencies' control. As instructed by the Board, staff brought amendments to the ZBus rule to the Board, which were adopted at the June 24, 2004, public hearing[2]. These amendments to the ZBus program were made to conform to market conditions and the availability of ZBuses. The amendments to the ZBus program were necessary and appropriate.

Staff is bringing this proposal to the Board to make additional amendments to the ZBus sections of the Fleet Rule for Transit Agencies.

Regulatory Authority

The ZBus requirements are an integral part of California's mobile source control efforts, and are intended to encourage the development of advanced technologies that will secure increasing air quality benefits for all Californians, particularly the majority of Californians who live in areas where the federal and State ambient standards for ozone are exceeded. The proposed amendments address the current state and availability of ZBus technology, and reduce the overall cost of compliance to the transit agencies while maintaining the push towards ZBus commercialization.

ARB has been granted the authority to regulate emissions through Health and Safety Code 43013 and 43018. These sections direct the ARB to adopt emission standards to reduce emissions from new motor vehicles, including urban transit buses, and achieve air quality attainment goals. They direct the ARB to assure that its motor vehicle emission standards are cost-effective, and the ARB endeavors to provide maximum flexibility.

Applicability

The Fleet Rule for Transit Agencies regulates transit fleet vehicles that are owned or leased by public transit agencies, including transit buses that meet the definition of an urban bus. The Zero Emission Bus (ZBus) portion of the regulation applies to those fleets that have more than 200 urban buses.

An urban bus is a passenger-carrying vehicle that is powered by a heavy heavy-duty diesel engine (33,000 Gross Vehicle Weight), with a load capacity of fifteen or more passengers and intended primarily for intra-city operation. These buses are generally 35 feet in length or longer. Urban bus operation is characterized by short rides and frequent stops. To facilitate this type of operation, more than one set of quick operating entrance and exit doors would normally be installed. Since fares are usually paid in cash or token, rather than purchased in advanced in the form of tickets, urban buses would normally have equipment installed for the collection of fares. Urban buses usually operate on a fixed route consisting of stops and starts as passengers are routinely picked up and delivered to their destinations. Urban buses are also typically characterized by the absence of equipment and facilities for long distance travel, e.g., restrooms, large luggage compartments, and facilities for stowing carry-on luggage[5]. Implementation timelines for ZBuses are set by the fuel path that the agencies have chosen to follow: Diesel or Alternative Fuel.

[5] ARB. February 24, 2005. Final Regulation Order: Modifications To The Fleet Rule For Transit Agencies And New Requirements For Transit Fleet Vehicles

III BACKGROUND

California's regulations applicable to transit agencies and the manufacturers of urban bus engines and vehicles are innovative and go beyond the federal requirements for urban buses. Since rule adoption, many transit agencies have installed natural gas refueling infrastructure and purchased alternative-fuel urban buses; re-powered diesel engines to cleaner exhaust emission standards; installed particulate filters on diesel engines and experimented with developing technologies, such as Diesel Hybrid Electric Buses (DHEB) and cleaner fuels. Many of California's transit agencies consider themselves to be innovators and incubators for advanced technologies.

The Board adopted the ZBus requirements (Title 13, CCR, Section 1956.3, recently moved to section 2023.3) in 2000 as part of the comprehensive fleet rule for transit agencies within California[1]. The development of zero emission transportation is key to California's long-term clean air strategy and the ZBus regulation establishes demonstration and acquisition criteria for large transit agencies to further that goal. Zero emission technologies include battery electric buses, electric trolley buses with over-head twin-wire power supply, and fuel cell electric buses. A "zero emission bus" is defined as producing zero exhaust emissions of any criteria or precursor pollutant under any and all possible operational modes and climates. "Criteria pollutants" are those for which the ARB has adopted ambient air quality standards[5].

In addition to reducing the public's exposure to smog forming emissions the transit bus regulation aimed to reduce toxic air contaminants and be technology forcing by requiring zero emission engines.

A ZBus Initial Demonstration Requirements

Any transit agency on the diesel path that had more than 200 urban buses as of January 31, 2001, was required to implement a ZBus demonstration project. Up to three transit agencies could participate in any one joint project, provided the project did not utilize electric trolley buses. Originally, the key components and milestones of the demonstration project were as follows:

- Transit agencies were to prepare bid proposals for materials and services necessary to implement the demonstration project no later than January 1, 2002.
- The required ZBuses were to be in revenue service no later than July 1, 2003.
- Transit agencies were to place at least three ZBuses in revenue service per participating agency, but up to three transit agencies in an air basin could petition to implement a joint demonstration project.
- The buses must be in revenue service for a minimum duration of 12 calendar months.
- Transit agencies were to submit a report on the demonstration project to the ARB's Executive Officer no later than January 31, 2005.
- The ARB was to review ZBus technology and the feasibility of implementing the purchase provision of the program (described below) no later than January 2006.

B Transit Agencies in the Initial Demonstration

In 2001 there were 71 transit agencies reporting to the ARB, 44 of which were on the diesel path. Of these, only five transit agencies met the criteria for having to implement a ZBus demonstration project (Table III-1).

Table III-1: ZBus Demonstration Transit Agencies

Transit Agencies Required to Implement ZBus Demonstration Project
Alameda/Contra Costa Transit District
Golden Gate Bridge Highway and Transportation District
San Francisco Municipal Railway
San Mateo County Transit District
Santa Clara Valley Transportation Authority

Of the five eligible transit agencies, four are participating in fuel cell bus demonstrations and the fifth, San Francisco Municipal Railway, is using its electric trolley fleet to meet the ZBus demonstration requirements. The four transit agencies formed two partnerships, with Alameda/Contra Costa Transit District (AC Transit) being joined by Golden Gate Bridge Highway and Transportation District (GGT), and Santa Clara Valley Transportation Authority (VTA) being joined by San Mateo County Transit District (SamTrans). In addition, SunLine Transit Agency joined the AC Transit and GGT partnership voluntarily and purchased one bus; the number of buses operated by SunLine does not require their participation in a ZBus demonstration.

AC Transit, GGT and SunLine are demonstrating four Van Hool transit buses equipped with United Technology Corporation (UTC) fuel cells and Nickel sodium chloride (ZEBRA) batteries in a hybrid configuration. AC Transit and GGT jointly operate buses in the Oakland area while SunLine operates a single bus in and around Thousand Palms. VTA and SamTrans are operating three Gillig Corporation transit buses equipped with Ballard fuel cells in the San Jose area.

C Progress on the Initial Demonstration

The transit agencies selected fuel cell powered buses as the technology most likely to cost-effectively meet the required performance standards and emission requirements in the long term. As the ZBus regulation was being developed, fuel cell technology had demonstrated greater potential to meet transit agencies' power, range, and refueling requirements than battery electric zero emission buses and offered greater route flexibility and focused infrastructure needs when compared to over-head wire trolley buses. Already, buses equipped with direct hydrogen, proton exchange membrane (PEM) fuel cells or with, on-board methanol reforming, phosphoric acid fuel cells had been demonstrated successfully. In addition, fuel cell manufacturers anticipated being production ready by 2003.

Information available indicated that the research and development of fuel cells in transit buses would lead to their deployment in transit buses before their application in light duty vehicles[6]. Buses are better suited to handle the relatively larger size and weight of fuel cells and on-board fuel storage. The deployment of fuel cells in a controlled fleet application would allow fueling and service requirements to be performed at a single facility, thereby helping to mediate infrastructure and support issues in the early years. As it turns out, fuel cell and vehicle manufacturers switched focus then towards developing light duty vehicle fuel cell applications. As a result, fuel cell bus engines have not yet reached commercialization.

The transit agencies demonstrated due diligence in attempting to comply with the demonstration requirements. For example, AC Transit and VTA, the lead transit agencies of the two ZBus demonstrations, individually initiated efforts to develop ZBus programs as the ZBus regulation was being promulgated. Transit agencies solicited bids for the purchase of FCBs with sufficient lead time to meet regulatory requirements. However, transit agencies experienced difficulties in receiving responses from fuel cell and bus manufacturers. Despite the exemplary efforts, the FCBs could not be delivered in time to allow the demonstration to be completed prior to January 2005. The FCBs for the VTA demonstration were not received until second quarter 2004 and the FCBs for AC Transit were not received until fourth quarter 2005. As a result, the in-revenue demonstrations of the FCBs started over one year after the originally required start date.

In addition, the cost of buses was greater than anticipated. During the development of the original rulemaking, in 1999, ARB estimated that by 2001 the cost for a demonstration FCB would be just in excess of $1 million and by 2003/2004 a FCB would be around $550,000 to $790,000, or cost competitive with electric trolley buses by the time the ZBus purchase requirements started[6]. However, the cost of a FCB for the initial demonstration was greater than $3 million[7]. By soliciting partners, the lead transit agencies were able to secure additional funding to allow the demonstrations to go forward despite the increases in cost.

In June 2004, staff presented an update on the demonstration projects and proposed amendments to the Board. After reviewing the status of technology, cost and bus availability, the Board recognized the need to revise the number of concurrent, in-use fuel cell buses that must be demonstrated, and delayed the start of the demonstration projects until the end of February 2006[2]. The state of technology, delay in the availability of fuel cell buses to California, and the data from European fuel cell buses justified reducing the number of buses required in California to three per demonstration project, instead of three per transit agency. This brought the costs of the demonstration project back to that projected in the original rulemaking[8].

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[6] ARB. December 10,1999. Staff Report: Initial Statement of Reasons: Proposed Regulation for a Public Transit Bus Fleet Rule and Emission Standards for New Urban Buses

[7] NREL VTA Evaluation Report, 02/06

[8] ARB. May 7, 2004. Staff Report: Initial Statement of Reasons. Proposed modifications to the exhaust emission standards and test engines and vehicles, the fleet rule for transit agencies, and zero-emission bus requirements.

D Existing ZBus Purchase Requirements

The originally-adopted purchase requirements remain in effect. Large transit agencies (those with more than 200 buses) on either fuel path are required to implement the ZBus purchase component of the program. For transit agencies on the diesel fuel path, a 15 percent aggregate total of all bus acquisitions from model year 2008 through model year 2015 must be ZBuses. For transit agencies on the alternative fuel path, the 15 percent ZBus acquisition requirement starts with model year 2010 and runs through model year 2015. Transit agencies on the diesel path must submit a compliance plan by January 2007 and transit agencies on the alternative fuel path must submit a compliance plan by January 2009. Any request for deviation from the ZBus purchase requirement must be submitted to, and approved by, the Executive Officer prior to the transit agency's submittal of the purchase order.

IV Technology Development Activities

While fuel cell bus technology has not develop as quickly as anticipated and there appeared to be a decrease in fuel cell bus related activities initially, the activities described below indicate a growing interest by various fuel cell and bus providers as well as the transit agencies world wide seeking to deploy fuel cell buses.

Fuel Cell Bus Programs[9]

California is not alone in promoting and demonstrating fuel cell buses. Internationally, over 50 hydrogen fuel cell and hybrid hydrogen fuel cell buses have already completed or are currently involved in at least 10 different demonstration projects. CUTE (Clean Urban Transport for Europe) placed 3 hybrid fuel cell urban buses using Citaro chassis and Ballard fuel cells in 9 different European cities for two year demonstration programs. The same bus and fuel cell system was deployed in additional programs in Reyjavik, Iceland and Perth, Australia. These projects were so successful that many of these cities are looking into extending demonstration times. Additionally, in Japan, Toyota and Hino are demonstrating a fuel cell bus in airport to city transport service and Hyundai held trial operation of fuel cell buses during this year's World Cup. In addition, over 220 hydrogen fuel cell buses have been proposed for the next five years under separate programs. Shanghai, China and San Paulo, Brazil are currently in testing stages of the United Nations Development Program Global Environment Facility's fuel cell bus demonstration program. The Natural Resources Canada Fuel Cell Program has plans for over 20 buses to be in demonstration by 2009 in Whistler, Canada. Upcoming Olympic Games have inspired city officials in Beijing, Vancouver, and London to call for large scale hydrogen fuel cell bus demonstrations.

Domestically, 12 buses under 3 different demonstration programs have been or are currently being completed. Throughout the United States, fuel cell bus demonstrations have already been completed in Santa Clara, California, under the California Fuel Cell Partnership program, and Washington D.C., under the Federal Transit Administration (FTA) funded Georgetown Fuel Cell Bus Program. The Georgetown Fuel Cell Bus Program allows testing and research at the University of California, Davis and the University of Northern Florida in Jacksonville on two separate transit buses manufactured by Bus Manufacturing USA, Incorporated and fitted with Fuji fuel cell stacks. In Honolulu, Hawaii one hybrid fuel cell bus is currently in service on Hickam Airbase as a flight crew transportation vehicle. Future projects funded by the FTA Automotive Based Fuel Cell Hybrid Bus program are planned in Alabama, Delaware, and Connecticut. Under the Greater Columbia Fuel Cell Challenge, the University of South Carolina and the City of Columbia have also been encouraged to engage in hydrogen fuel cell bus demonstrations.

[9] ARB. "Summary of Demonstration Projects" (http://www.arb.ca.gov/msprog/bus/zeb/fcbdemos.pdf) 07/10/06

In addition, the United States Department of Transportation (U.S. DOT) has been allotted $49 million over four years for the advancement of fuel cell transit buses. This U.S. DOT program requires 50 percent match funding from successful proposals. Solicitation for white papers describing potential projects have been made and evaluated. Projects in California have been selected to participate in the final round of consideration. Even if a California program is not selected the U.S. DOT fuel cell bus advancement program assures additional fuel cell bus development activity.

V NEED FOR REGULATORY AMENDMENTS

Zero Emission Bus Demonstration and Purchase Requirements

After reviewing the status of technology and bus availability, staff sees a need to revise the start date of the zero emission bus purchase requirements due to high bus costs, and unproven durability, reliability, and ability of manufacturers to produce the number of buses required by the regulation. To keep the momentum moving forward, encourage fuel cell manufacturers to increase their production numbers, show that integration of a larger zero emission bus fleet is possible, and prove that the costs can be decreased, staff has included an Advanced Demonstration program and a delay in the purchase requirement in the proposed amendments.

While still on-going, the demonstrations at VTA, AC Transit, and SunLine have demonstrated the viability of fuel cell powered transit buses. The buses have been operated on numerous routes and have successfully proven their ability to perform on hilly terrain, on high-speed highways, and in-city stop-and-go applications. The reaction from the public has been positive with riders appreciating the much quieter operating characteristics of the fuel cell powered buses. In addition, the hybrid configured fuel cell buses used by AC Transit and SunLine are demonstrating a fuel efficiency of 7.6 miles per kilogram of hydrogen[4,10]. This nearly doubles the fuel economy compared to diesel buses. However, additional work is necessary to demonstrated reliability and durability concerns. Reliability is typically measured by the miles between propulsion related road calls. For diesel buses this occurs roughly once every 11,000 miles[7]. VTA data shows that propulsion related road calls for their fuel cell buses occurred roughly once every 1000 miles[7]. The AC Transit experience is expected to be much better, but data is not yet available.

Zero emission technology is more expensive compared to conventional transportation technology. San Francisco Municipal operates the largest fleet of electric trolley buses in the United States, with 344 trolleys[11] on 186 miles of infrastructure. In 1997, an electric trolley without infrastructure cost about $800,000[12]. However, it is important to consider that the infrastructure costs associated with electric trolleys, is between $1 and $1.5 million per mile. The cost variability is related to additional electricity generation equipment needed for inclines and route variations. Though the initial costs incurred by the transit agency are significantly higher, decreased operation and maintenance costs, and longer useful life add an incentive to this type of technology. Residents prefer the quieter trolley buses over the diesel buses. In addition, diesel buses had significant operating problems under full passenger load on the hills in San Francisco. Many of these routes were converted to electric trolley bus service since the high startup torque

[10] Paul Scott. "ZEB and NZEB Program Progress plus…Comments on ZEB Program Plan." Presented at 04/14/06 workshop. http://www.arb.ca.gov/msprog/bus/zeb/meetings/041406/ise41406.pdf
[11] SF Muni, "About Trolley Buses" http://www.sfmuni.com/cms/mms/rider/trolley.htm
[12] City and County of San Francisco. Contract No. 888. Procurement of Articulated & Standard Trolley Coaches: Attachment No. 3 page IV-7, Schedule of Prices. 06/27/97

of an electric motor allowed the trolley buses to handle the hills better than the diesel buses. Staff expects fuel cell buses to behave similarly to electric trolleys.

New and developing technology costs are typically much higher but decrease as the technology progresses. The cost of AC Transit buses, equipped with UTC fuel cells, were $3.2 million each[13]. Just over a year later the same fuel cell bus will be about $2.25 million[3]. While this is a significant reduction without a change in technology, this is still greater than anticipated costs. However, more demonstrations around the world each year are rapidly increasing the number of fuel cells, thus expanding manufacturer's knowledge base. According to UTC, once about 100 fuel cell buses are ordered, the price will drop to about $1 million[4]. Staff anticipates that cost will decrease further and become more inline with other technologies as the volume produced increases and the technology become more mainstream. In view of San Francisco Municipal's success with electric trolleys, a zero emission technology, costing in 1997 nearly $800,000 each[12], staff finds a $1 million purchase price for a fuel cell bus is comparable as a start for the 15 percent purchase requirement. In San Francisco Municipal's comparisons of diesel and electric trolleys, costs associated with either technology are equivalent over a bus's useful life. Staff anticipates the lower operation and maintenance cost associated with electric trolleys will also be applicable to fuel cell buses as the technology advances.

Staff is proposing an Advanced Demonstration and to phase in the 15 percent purchase requirement based on the cost, performance, and reliability of the technology. An Advanced Demonstration will allow transit agencies to gain experience in fleet operation of a new technology while gaining confidence in the technology's ability to deliver the required performance. The Advanced Demonstration will allow transit agencies to form a multi agency partnership that can demonstrate a single, relatively large fleet of buses without individually having to bare the full cost of a large fleet demonstration. The Advanced Demonstration will also allow technology providers to increase production levels, thereby implementing cost reductions, and to demonstrate improved technology performance.

Staff is also proposing to correlate the percent purchase requirement to performance targets. By tying the purchase requirements to the performance of the technology, transit agencies will have greater confidence in the technology's ability to perform as needed. In addition, fuel cell providers will be assured of a return on investment for meeting performance targets. This approach will allow the regulation to be smoothly implemented as the technology becomes market ready without further intermittent amendments.

As evidenced by the fuel cell bus activities underway outside of California, focus seems to have returned to fuel cell applications in buses. Based on comments received from fuel cell manufacturers, Ballard and UTC, it appears that improved fuel cells will become available within the next three years. After considering the number of buses in demonstrations world wide, the cost per bus and the state of the technology staff

[13] Jaimie Levin, Director of Marketing and Communications, AC Transit. 07/17/06

recommends amending the regulation, as described in more detail in Section VII, to add an Advanced Demonstration, delaying the purchase requirement and establishing performance targets for the implementation of the purchase requirement.

VI PUBLIC OUTREACH AND ENVIRONMENTAL JUSTICE

The ARB is committed to ensuring that all California communities have clean, healthful air by addressing not only the regional smog that hangs over our cities but also the more localized toxic air pollution that is generated within our communities. The ARB works to ensure that all individuals in California, especially children and the elderly, can live, work and play in a healthful environment that is free from harmful exposure to air pollution.

A. Environmental Justice

On December 13, 2001, the Board approved Environmental Justice Policies and Actions, which formally established a framework for incorporating environmental justice into the ARB's programs, consistent with the directives of State law and policy[14]. "Environmental Justice" is defined as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. These policies apply to all communities in California but, environmental justice issues have been raised more in the context of low-income and minority communities because of past land use policies and the accumulative impact of a concentration of emitting facilities in some neighborhoods.

To achieve this goal, the ARB has established a Community Health Program and emphasized community health issues in our existing programs. ARB has published, "The Public Participation Guide to Air Quality Decision Making in California" to use as a basic tool and for information needed to understand and participate in air pollution policy planning, permitting, and regulatory decision making processes[15]. The Environmental Justice Policies are intended to promote the fair treatment of all Californians and cover the full spectrum of ARB activities. Underlying these Policies is a recognition that we need to engage community members in a meaningful way as we carry out our activities. People should have the best possible information about the air they breathe and what is being done to reduce unhealthful air pollution in their communities. The ARB recognizes its obligation to work closely with all stakeholders; communities, environmental and public health organizations, industry, business owners, other agencies, and all other interested parties to successfully implement these policies. Our outreach efforts, described below, facilitate this objective.

B. Outreach Efforts

The ARB strives to involve the widest number of affected persons in the development of its regulations. To this end, staff held informal public workshops and meetings prior to publishing the notice and staff report. Information from these workshops can be found through the Zero Emission Bus program website[16]. For this rule, staff conducted four

[14] Information for these programs can be found at http://www.arb.ca.gov/ch/programs/ej/ejpolicies.pdf.
[15] Information on this program can be found at http://www.arb.ca.gov/ch/public_participation.htm.
[16] More information on ZBus Programs can be found at http://www.arb.ca.gov/msprog/bus/zeb/zeb.htm

public workshops (Table VI-1) and additional focused meetings. Notices for the workshops were posted to ARB's Public Transit Agencies web site and e-mailed to subscribers of ARB's electronic list server. Those workshops held in Sacramento were webcast for individuals who could not travel to the meeting locations. Participation in Southern California workshops was available by telephone conference. To generate additional public participation and to enhance the information flow between ARB and interested persons, staff made all documents, including workshop presentations, available via the Zero Emission Buses web site. In addition, the web site provides background information and serves as a portal to other web sites with related information.

Table VI-1: Workshop Locations and Times

Date	Location
October 27, 2005	Sacramento
January 27, 2006	El Monte
April 14, 2006	Sacramento
June 21, 2006	Diamond Bar

Outreach and public participation are important components of ARB's regulatory development process. In preparing the proposed regulations, ARB staff developed an outreach program to engage Zero Emission Bus equipment manufacturers and distributors, emission control system manufacturers, transit agencies, end-user facility operators, local air pollution control districts, environmental organizations, public health advocates, and other interested parties.

As part of the outreach efforts, ARB staff made extensive personal contacts with industry and facility representatives as well as other affected parties through meetings, telephone calls, and electronic list-serves. These activities included holding four public workshops, attending 28 industry meetings and conducting more than 30 telephone conversations with working groups, transit agencies, affected manufacturers and other interested stakeholders.

Attendees of the workshops included representatives from environmental organizations, transit agencies, fuel cell manufacturers, bus manufacturers, air pollution control districts, cities and counties, California Natural Gas Association, California Energy Commission, consultants, and other parties interested in transit bus emissions[17].

Staff met with a number of the same stakeholders in focused meetings throughout the rulemaking process to get feedback on staff's proposed regulatory amendments. These stakeholders represent transit agencies, hybrid-electric drive systems, bus manufacturers, natural gas advocates, and environmental organizations. Staff attended and made presentations at the California Transit Association conference in May 2006. Staff also worked closely with ZBus stakeholders, including AC Transit, VTA, SunLine

[17] Sign-in sheets available on ZBus website: www.arb.ca.gov/msprog/bus/zeb/meetings/meetings.htm

Transit, California Energy Commission, National Renewable Energy Laboratory, South Coast Air Quality Management District, Ballard Power Systems (Ballard), ISE, and United Technologies Corporation Fuel Cells (UTC). Alternatives were suggested to the proposed regulation and explored by staff.

VII REGULATORY PROPOSAL

Staff has worked with zero emission bus fuel cell, electric drive system and chassis equipment manufacturers and distributors, end-user facility operators, federal regulatory agencies, environmental groups, and other interested parties since October 2005 to identify approaches that would result in viable implementation for zero emission buses. The most promising options involve adding an Advanced Demonstration and, postponing and extending the purchase requirement. Staff conducted workshops in October 2005, January, April, and June 2006 on these approaches.

Staff recommends that the Board adopt proposed amendments to sections 2023.1, 2023.3, and 2023.4 of title 13, as set forth in Appendix A. All the provisions in the proposed amendments apply to engines and vehicles produced for sale in California. There are three main components to this proposal:

1) Add an Advanced Demonstration for the diesel path and an optional demonstration for the alternative fuel path transit agencies that have a fleet of at least 200 urban buses by January 1, 2007;
2) Amend the ZBus purchase requirement
   - Postpone the start date by 1-3 years, depending on transit agency path and demonstration option
   - Extend the purchase requirement out 15 years from the start date
3) Incorporate an Executive Officer Discretion Clause
   - Allow the Executive Officer to reduce the purchase requirement percentage based on the performance and cost targets achieved
   - Includes an annual review of the performance and cost parameters
   - First analysis of performance and cost parameters to occur 18 months prior to January 1, 2011 purchase requirement.
4) Amend other sections as necessary to conform and clarify, such as
   - Realign the Early Purchase Credits with the new purchase requirement dates.
   - Reporting requirements are extended for Transit agencies with over 150 urban buses.

A Amendments to the Zero emission Bus Rule, title 13, CCR, section 2023.3

1 Advanced Demonstration Requirement

i Single Agency Option

Diesel path transit agencies choosing to conduct a demonstration on their own would be required to purchase at least six zero emission buses. Buses need to be in revenue service as of January 1, 2009.

Alternative fuel path transit agencies may choose to conduct a demonstration on their own provided it involves the purchase of at least six zero emission buses. By participating in an advanced demonstration transit agencies will receive a one year

delay in the purchase requirement. In addition, transit agencies will be able to gain expertise in the operation and support of fuel cell buses with a smaller number of buses. All buses need to be in revenue service by January 1, 2010.

ii Zero Emission Enabling Bus Option

The zero emission enabling bus option is in response to comments received during the workshops and is only applicable to alternative path transit agencies during the advanced demonstration. Zero Emission Enabling buses would be required to use a technology that helps to develop zero emission technology. For example, buses that use gaseous hydrogen or gaseous hydrogen blended with natural gas, or a gaseous fuel hybrid configuration, would be considered zero emission bus enabling. Current development in zero emission enabling technology buses has included applications of straight hydrogen and hydrogen blended with natural gas in ICEs. A zero emission enabling bus would need to be certified to the applicable 2010 standard and demonstrate emissions at least 50 percent cleaner than the 2010 standard. All buses utilizing this option need to be in revenue service by January 1, 2010.

The zero emission enabling bus option could allow transit agencies to demonstrate cleaner conventional ICE technology while developing expertise leading to the deployment of ZBuses. The intent of the zero emission enabling bus demonstration option is to foster the development of zero emission bus technology and cleaner lower emitting internal combustion engine (ICE) technology. Only half of the ZBuses required under the demonstration can be replaced. For each ZBus replaced at least three zero emission enabling buses must be purchased.

Depending on the alternative fuel used, transit agencies could deploy hydrogen infrastructure and still use a bus technology similar to buses used in their current operation. For example transit agencies using natural gas fueled ICE buses could operate ICE buses that run on a blend of hydrogen and natural gas. ICE buses operating on straight hydrogen would utilize the same on-board storage systems as fuel cell buses thereby familiarizing transit agencies with higher pressure hydrogen systems, and supporting a transition to ZBuses. The Executive Officer would approve a qualifying zero emission enabling bus demonstration.

iii Multiple Agencies Option

Each diesel path transit agency choosing to participate in a demonstration with other transit agencies is required to purchase at least three zero emission buses, with a minimum combined total of 12 new zero emission buses. While multi-transit agency demonstrations can be conducted with any type of zero emission bus strategy the demonstration cannot be conducted using existing electric trolley systems. All demonstration buses need to be in revenue service as of January 1, 2009.

Each alternative fuel path transit agency choosing to participate in a demonstration with other transit agencies is required to purchase at least three zero emission buses. In

addition, the multi-transit agency demonstration needs a minimum of 12 zero emission buses. Alternative fuel path transit agencies can also choose to replace some zero emission buses with zero emission enabling buses provided that less than half of the zero emission buses required under the demonstration are replaced. As previously described, three zero emission enabling buses replace one zero emission bus. Using the zero emission enabling bus option a twelve ZBus demonstration would require the purchase of at least six zero emission buses. The remaining buses can be replaced on a three zero emission enabling buses to a one zero emission bus ratio. All buses need to be in revenue service by January 1, 2010.

2 Purchase Requirement

The start of the purchase requirement for diesel path and alternative fuel path transit agencies would be delayed until January 1, 2011, unless the alternative fuel path transit agency participated in the Advanced Demonstration. The purchase requirement for alternative fuel path transit agencies opting to conduct an Advanced Demonstration would start January 1, 2012. The purchase requirements would run through model year 2026 for either fuel path. Currently, the purchase requirement ends in 2015. The purchase requirements are being extended to help assure one complete fleet turnover has occurred.

3 Performance Based Purchase Requirement

To provide performance goals and production targets for manufacturers and confidence to transit agencies, staff proposes to include a provision under which no later than June 30, 2009, the Executive Officer is to evaluate the purchase cost, fuel cell durability or warranty, and reliability or availability of the ZBus.

Staff proposes that initial costs be compared with electric trolleys, which is also a zero emission technology. It is expected that like electric trolleys, fuel cell buses will have less maintenance than diesel or alternative fuel buses over the life of the bus. Due to this expectation, the life cycle costs for fuel cell buses and electric trolleys are expected to be comparable to conventional buses. In addition, the warranty length/durability and reliability should also be similar to conventional engines. The table below lists the performance guidelines and purchase requirement percentage. The ability of manufacturers to meet the performance goals will be analyzed 18 months prior to the initial purchase requirement and annually thereafter. This determination would start June 30, 2009, and would be reassessed annually by June 30th of each year following until the goals are met. If all goals are met, the 15 percent purchase requirement is fully implemented. If these goals are not met, then the Executive Officer can reduce the purchase requirements according to the guidelines on Table VII-1.

Table VII-1: Performance and Purchase Requirements for ZBuses

	15 percent	8 percent	2 percent
Initial Cost FCB: (Electric Trolley)	1.25:1	1.75:1	3:1
FC Durability or warranty (hrs)	20,000	15,000	3,000
Reliability (miles[18]) or Availability (percent)	10,000 or 80 percent	7,500 or 70 percent	4,000 or 60 percent

Staff compared average warranties, reliability of propulsion systems, life cycle costs, and initial purchase costs of diesel, natural gas, and fuel cell buses. Staff concluded that initial cost, reliability, and fuel cell durability should be monitored and used to determine the appropriate purchase requirement for zero emission buses.

While staff believes that life cycle costs could be a better indicator, staff also believes that this area is still under development and too premature to use as a guide to determine purchase requirements. Due to the limited number of fuel cell buses in operation, insufficient data is available for an accurate life cycle cost analysis. In addition, one life cycle will not have been realized before the regulation would take effect. Information from industry indicates that in the future, operating and maintenance costs for fuel cell hybrid buses will be less than diesel and compressed natural gas (CNG) buses[4,19]. Therefore, staff is using reliability of the propulsion system and durability of the fuel cell as parameters to ensure that the bus operation is at least comparable with conventional engines.

In order for fuel cell buses to be competitive, the durability needs to be similar to conventional urban bus technology, therefore staff proposes as a performance goal durability to be 5 years, 300,000 miles or 20,000 hour for each fuel cell bus propulsion system. The hourly rating was added, since fuel cell bus demonstrations used this as a parameter in their warranty. Thus a 20,000-hour durability would convert to 240,000 to 360,000 miles, with the average speed of a bus depending on the route, ranging from 12 to 18 miles per hour. Since, the technology may not have time to demonstrate this prior to the purchase requirement, staff proposes that the warranty conditions on the fuel cell or propulsion system be considered to determine the status of the technology.

Warranties currently offered for diesel and CNG urban bus engines cover all major propulsion subsystems, minus oil and filter changes as well as less significant parts. John Deere offers a warranty for a CNG urban bus engine that covers three years or 350,000 miles, whichever occurs first[20]. A typical diesel engine warranty runs for five years or 300,000 miles[21]. Warranty costs are usually included into the total engine price. For conventional technologies, extended warranties are also available for an extra cost, at around $2,000 to $4,000 per year[21,22].

[18] Miles between propulsion related road calls.
[19] Jaimie Levin, Director of Marketing and Communications, AC Transit. 7/20/06
[20] Bob Bach, Director of Maintenance, Omnitrans. 7/13/06
[21] Art Douwes, Senior Mechanical Engineer, VTA. 7/14/06
[22] Michael Eaves, President, California Natural Gas Vehicle Coalition. 7/20/06

For the VTA hydrogen fuel cell bus demonstration, Ballard provided a two year, or 1,000 hour warranty[21]. This covered everything pertaining to the fuel cell stack which acted as the propulsion system. UTC offered a two year, 4,000 hour warranty to AC Transit for its hybrid fuel cell bus demonstration program, which also provided full coverage for the fuel cell stack, battery, and other parts associated with the propulsion system[13]. Demonstration warranties are not equivalent to actual service warranties. If the bus were to run 12 hours per day, 365 days a year, total running hours would amount to nearly 4,500 hours each year.

Reliability, expressed as miles between road calls, for diesel, CNG and liquid natural gas (LNG) propulsion systems is fairly well documented by transit agencies. In the VTA demonstration, miles between road calls for diesel propulsion related issues was 11,400, while for fuel cell buses it was about 1000 miles[7]. AC Transit data is expected to be much better due in part to the hybridized fuel cell/battery system; however data is still preliminary and has not been released. Orange County Transportation Authority states that for LNG buses, propulsion related road calls occur every 13,400 miles[23]. While for CNG buses road calls occur between 4,600[24] to 18,500[25] miles. However, it is important to note that how a road call is defined and what failure warrants a road call differs between transit agencies. Some of the variability in road calls is due to this. Staff estimates that propulsion related road calls for diesel or alternative fuel buses using established technology will occur about every 10,000 miles. These numbers are highly dependent upon the operator's and maintenance technician's labor contracts and/or ability to diagnose and prevent future problems through routine maintenance. Therefore, staff estimates that a reliability of 10,000 miles between propulsion related road calls is an appropriate guide for fuel cell buses.

To adjust for this variability, staff is also incorporating the availability of the buses. This parameter includes maintenance and road calls. The reliability and availability parameters will be evaluated jointly and only one parameter will be needed to fulfill the requirements of the Executive Officer Discretion. Availability will be evaluated on a percentage basis. According to the NREL report for VTA availability of diesel buses are approximately 80 percent[7]. Therefore, 80 percent availability will be the basis for which the ZBuses will be compared to for the 15 percent purchase requirement. A minimum of 60 percent availability will be required to meet the 2 percent purchase requirement level.

4 Non-Urban Zero Emission Bus Exemption

Urban buses are defined as vehicles that are powered by a heavy-heavy duty engine, have gross vehicle weight rating of 33,000 pounds, and that carry at least 15 passengers in an urban environment with scheduled stops. Some hybrid system

[23] Ryan Erickson, Maintenance Facility Manager, Orange County Transportation Authority. 7/20/06
[24] Bob Bach, Director of Maintenance, Omnitrans. 7/20/06
[25] George Karbowski, Director of Operations and Maintenance, Foothill Transit. 7/20/06

manufacturer utilize smaller engines and some bus manufacturers are developing chassis made of lightweight composite materials with reduced nominal curb weights. Even when fully loaded such buses may weigh less than 33,000 GVW[26]. Staff agrees some balance is necessary in assisting markets to develop for new technologies. Staff proposes that lightweight buses that are equipped with zero-emission engines, designed to operate in urban bus service, and carry a similar manufacturer chassis warranty could be considered an urban bus for the purpose of the zero emission bus regulation. Manufacturers would submit documentation showing how their bus technology compares to an urban bus. The Executive Officer would have discretion to determine if the bus would qualify as zero emission urban bus.

B Amendment to Reporting Requirements, title 13, CCR, section 2023.4

Staff is proposing to amend this section to extend the reporting requirements from 2015 to 2027 for transit agencies operating 150 or more urban buses. Transit agencies will be required to report:

- number of buses, manufacturer, make, and model year of engines
- fuel used for each urban bus that it currently owns or operates
- urban bus purchases and/or leases
- annual average percentage of total urban bus purchases and/or leases that were zero emission buses.

The reporting requirement is extended to allow ARB to track compliance with the Zero Emission Bus regulation and to track the fleet size of transit agencies that could through growth qualify for the ZBus purchase requirement.

[26] ARB. September 6, 2002. Staff Report: Initial Statement of Reasons. Proposed Modifications to the public transit bus fleet rule and interim certification procedures for hybrid-electric urban transit buses

VIII ENVIRONMENTAL IMPACTS

In support of the amendments to the zero emission bus regulation, staff has compiled the emissions inventory using the population reported by transit agencies and emission rates that reflect the latest inventory assumptions and urban bus rules. Survival rates (the fraction of the new vehicles that remains in the fleet after certain years) and annual mileage accrual rates by age developed for the "Proposed Amendments to the Exhaust Emission Standards for 2007-2009 Model-Year Heavy-Duty Urban Bus Engines and The Fleet Rule for Transit Agencies " were used to generate the inventory[27], [28].

For the purposes of this regulation, only emissions from transit agencies with over 200 buses at the respective implementation dates were used. In 2005, these transit agencies account for about 70 percent of all California's urban buses. Future population is based on bus survival rates and one percent growth. The proposed regulation is applicable to any transit agency that has over 200 buses during the life of the regulation. Therefore, the following table shows all the transit agencies that staff anticipates may eventually be affected by the proposed regulation, which include all transit agencies with over 150 buses. Therefore, transit agencies that have over 150 urban buses will be required to continue reporting requirements.

Table VIII-1: Transit Agencies with Over 150 Urban Buses in 2005

Agency	Regulation Effective Date	Fuel Path
Foothill Transit	Already Effected By Existing Regulation	Alt. Fuel
Los Angeles County MTA		Alt. Fuel
Orange County Transit Agency		Alt. Fuel
Sacramento Regional Transit		Alt. Fuel
San Diego Metropolitan Transit		Alt. Fuel
Alameda Contra Costa Transit		Diesel
Golden Gate Transit		Diesel
San Mateo County Transit		Diesel
Santa Clara Valley Transit		Diesel
San Francisco Municipal Railway	Meets ZBus requirements[29]	Diesel
Long Beach Transit	2008	Alt. Fuel
Santa Monica Big Blue Bus	2012	Alt. Fuel
Omnitrans	2014	Alt. Fuel
North County Transit District	unknown[30]	Alt. Fuel

[27] ARB. July 29, 2005. Staff Report: Initial Statement of Reasons, Proposed Amendments to the Exhaust Emission Standards for 2007-2009 Model-Year Heavy Duty Urban Bus Engines and the Fleet Rule for Transit Agencies.
[28] ARB. July 28, 2006. Final Regulation Order. Proposed Amendments to the Exhaust Emission Standards for 2007-2009 Model-Year Heavy Duty Urban Bus Engines and the Fleet Rule for Transit Agencies.
[29] San Francisco Municipal already exceeds the 15 percent purchase requirement through use of electric trolley buses
[30] In projected models, North County Transit District is unaffected by regulation. However, this transit agency could potentially meet the 200 bus minimum in later years.

Based on projected growth, an additional four transit agencies will be subject to the ZBus purchase requirement. Those four agencies account for an additional seven percent of all California's urban buses and are included in the state wide emission estimates. One of these transitional transit agencies, Long Beach Transit, is projected to have 200 urban buses by the 2009 trigger in the existing regulation. Therefore, Long Beach Transit is included in both the current and proposed emission scenarios. While, the other three transit agencies would not be subject to the existing regulation and are only included in the proposed emission scenarios. Table VIII-1 shows the transit agencies that are subject to the regulation. For those transit agencies that currently do not have 200 urban buses, the table identifies the year that the purchase requirement would begin, assuming the numbers grow as projected.

A Emission Standards

Staff used the emission standards for new urban transit buses shown on Table VIII-2 in calculating the emissions for the proposed regulatory amendments.

Table VIII-2: Emissions Standards (grams/brake horse power hour)

Buses Replaced	2008-2009		2010-2026	
	Diesel	NG	Diesel	NG
NMHC	0.14	0.14	0.14	0.14
CO	15.5	15.5	15.5	15.5
NOx	1.2	1.2	0.2	0.2
PM	0.010	0.010	0.010	0.010

B Current ZBus Emission Inventory

Table VIII-3 provides the estimated emission reductions from the existing regulation. The expected emission reductions were determined by calculating an emission reduction from a zero emission bus relative to a bus meeting the 2010 urban transit bus standard. This determines emission reductions above those that would be expected from a new diesel or alternative fueled bus. Actual emission reductions are higher since a new bus usually replaces a bus with at least 12 years of service, therefore retiring an older higher emitting bus[31].

Table VIII-3: Emissions Reductions from ZBuses based on Existing Regulation (Tons per Year)

Year	Oxides of Nitrogen (NOx)	Particulate Matter (PM)	Carbon Monoxide (CO)	Hydrocarbons (HC)

[31] These reductions are associated with other sections of the Fleet Rule for Transit Agencies.

2010	3.57	0.097	2.62	0.063
2015	11.7	0.620	16.8	0.405

C Proposed ZBus Emission Inventory Reduction

Table VIII-4 provides the emission impacts compared to the existing regulation from implementing Scenario 1; the current purchase requirements are delayed until 2011 for the diesel and alternative path transit agencies. Only the diesel path transit agencies conduct an Advanced Demonstration starting in 2009. The values represent the decrease in the emission reductions expected from the existing regulation.

Table VIII-4: Emissions Reductions based on Proposed Amendments from Scenario 1 Implementation (Tons per Year)

Year	NOx	PM	CO	HC
2010	(2.15)	(0.08)	(2.21)	(0.053)
2015	(2.21)	(0.08)	(2.29)	(0.055)

The existing regulation does not address purchase requirements beyond 2015 and staff assumes that purchases of zero emission buses will continue after 2015: although the percentage of the purchase is subject to a number of factors, and is not assured. The proposed regulation will guarantee that ZBus purchases and therefore emission reductions will continue through 2026, however the incremental amount of emission differences relative to the existing regulation, if any, is difficult to predict. Instead Table VIII-5, represents the emissions from the regulation as proposed.

Table VIII-5: Estimated Total Emission Reductions from the ZBus Regulation (Tons per Year)

Year	NOx	PM	CO	HC
2020	19	1.1	31	0.7
2023	22	1.3	38	0.9

D Impact of Other Compliance Scenarios

Staff estimated emissions impacts of two additional compliance scenarios. In Scenario 2, the current purchase requirements are delayed until 2011 for the diesel path transit agencies and 2012 for the alternative fuel path transit agencies that participate in the Advanced Demonstration. The diesel path transit agencies conduct an Advanced Demonstration starting in 2009 and the alternative fuel path transit agencies start the Advanced Demonstration in 2010. In Scenario 3, the current purchase requirements are delayed until 2011 for the diesel path transit agencies and 2012 for alternative fuel path transit agencies who participate in the Advanced Demonstration using the zero emission enabling bus option. The diesel path transit agencies conduct an Advanced Demonstration starting in 2009 and the alternative fuel path transit agencies start the

Advanced Demonstration in 2010. In this scenario, no emission reduction benefits are estimated for the zero emission enabling buses, such as CNG-hydrogen blended fuel buses and hydrogen internal combustion engine buses. Overall the emission impacts from Scenario 2 and 3 are similar and result in an additional emission reduction loss of about 4 percent for each pollutant compared to emission reductions seen under Scenario 1.

The use of zero emission enabling buses will create a slight reduction in emission benefits relative to allowing only ZBuses to meet demonstration requirements. Staff conservatively assumed zero emission enabling buses met the 2010 urban transit bus emission standard for purposes of this analysis even though zero emission enabling buses are expected to have much lower demonstrated emissions.

E Emission Impacts in the South Coast Air Basin

The following tables show the estimated emission impacts of the staff's proposal for the South Coast Air Basin. In general, the emission impacts of staff's revised proposal create a slight reduction in emission benefits through 2015 and an increase in emissions benefits by 2020. The effective start date of demonstration and purchase requirements is based on fuel path selected by the transit agency. All transit agencies in the South Coast Air Basin are on the alternative fuel path.

Table VIII-6 shows the emission impacts of the existing regulations. In the existing regulation alternative path transit agencies start the 15 percent ZBus purchase requirement in 2010.

Table VIII-6: South Coast Air Basin Emissions Reductions from ZBuses based on Existing Regulation (Tons per Year)

Year	NOx	PM	CO	HC
2010	0.652	0.042	1.148	0.028
2015	5.633	0.365	9.912	0.239

Table VIII-7 shows the emission impacts of Scenario 1 relative to the existing regulation, the alternative path transit agencies chose not to conduct an advanced demonstration program and the purchase requirement starts in 2011. In Scenario 2 and 3, the alternative fuel path transit agencies conduct a demonstration starting 2010 and initiate bus purchases in 2012. While Scenario 2 delays the purchase requirement for alternative fuel transit agencies, it does require some ZBus purchases one year earlier than if no demonstration was conducted. The values represent the decrease in the emission reductions expected from the existing regulation.

Table VIII-7: South Coast Air Basin Emissions Reductions based on Proposed Amendments from Scenario 1 Implementation (Tons per Year)

Year	NOx	PM	CO	HC
2010	(0.652)	(0.042)	(1.148)	(0.028)
2015	(0.417)	(0.027)	(0.734)	(0.018)

Table VIII-8 shows the reductions from the proposed regulation; Scenario 1 is used to represent the proposed amendments.

Table VIII-8: South Coast Air Basin Estimated Total Emission Reductions from the ZBus Regulation (Tons per Year)

	NOx	PM	CO	HC
2020	11	0.7	19	0.5
2023	13	0.9	24	0.6

As previously addressed, Scenario 2 and 3 are approximately the same and will not achieve as many reductions as Scenario 1, therefore the emission benefits will be less. The estimated emission reduction losses from Scenario 2 and 3 over Scenario 1 are approximately an additional 6 percent for each pollutant in the South Coast Air Basin.

IX ECONOMIC IMPACTS – COST AND COST-EFFECTIVENESS

A Legal Requirement

Sections 11346.3 and 11346.5 of the Government Code require State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California business to compete with out-of-state businesses.

State agencies are also required to estimate the cost or savings to any State or local agency and school districts in accordance with instructions adopted by the Department of Finance. This estimate is to include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the State.

B Affected Businesses

Any business involved in the production or use of zero emission buses potentially would be indirectly affected by the proposed regulation. Those potentially affected are manufacturers that supply components for fuel cells, batteries, integration systems, chassis, and distributors and retailers that sell such equipment. Most of these manufacturers are located outside of California. The regulation directly impacts transit agencies that operate 200 or more urban buses.

C Potential Impact on Businesses

Businesses that may be affected as a result of the proposed regulation include manufacturers of advanced, hybrid electric vehicles/engines, and urban bus manufacturers. One business that manufactures hybrid-electric engines is located in California. Therefore most impacts to these businesses, both positive and negative, will occur in other states.

Buses are manufactured in parts, one company builds the body, another the fuel cell propulsion system, and a third integrates the fueling system into the bus. Staff estimates that this proposal could potentially have adverse impacts on manufacturers of components for the zero emission buses because it delays bus purchase requirements. Staff believes that this will be realized primarily as a delay on the return of investments.

D Potential Impact on Small Businesses

Staff is not aware of any small businesses that are affected by this regulatory change.

E Potential Impact on Business Competitiveness

Staff believes there will be an effect on business competitiveness as it affects ISE Corporation (ISE), a California company that integrates the fuel cell technology, battery, and drive train components into the bus chassis. The proposed delay may allow other system integration companies to develop hybrid integration systems and these companies will likely benefit from this proposed rule, perhaps to the detriment of ISE's market. ISE is currently a leader for the integration of batteries and fuel cells in urban buses. Other transit agencies, which might have purchased the ISE integration system for the Hybrid Hydrogen Fuel Cell Buses (HHFCBs), may instead wait and purchase a HHFCBs with another system integration unit. Thus ISE may lose some of its potential market.

F Potential Impact on Employment

Staff believes that there may be some potential indirect impact on employment. With delays on investments for the fuel cell, providers may need to reduce employment numbers.

G Potential Impact on Business Creation, Elimination or Expansion

The proposed amendments could impact any of the companies involved in the manufacture, production, distribution and installation of fuel cell, alternative fuel, and diesel buses. Staff believes there will be no business elimination, and believes there will be no or minimal business creation or expansion, as a result of the adoption of the proposed amendments. Amendments to the regulation are proposed due to the bus technology not being commercially ready. A delay of the purchase requirements will make buses more cost-effective. Most manufacturers that could benefit from the potential indirect increase in business created by requiring fuel cell buses are located outside of California. To the extent that those businesses are located in California, the amendments could lead to the creation or expansion of businesses in California.

H Potential Cost to Local and State Agencies

The proposed regulation would not impose additional fiscal impacts on local public transit agencies when compared to the existing regulation. The direct economic impact is to the transit agencies. Staff projects an estimated cost savings to transit agencies of approximately $59 million over the four year period beginning January 2008.

1 Implementation Support

To determine implementation scenarios for costs, staff first evaluated existing funding available for transit agencies. Transit agencies use Federal Transit Administration (FTA) moneys and State and local matching funds to replace their buses. A vehicle's service life determines when a transit agency can apply for FTA funding, and the local

transportation agency prioritizes which transportation projects in its area obtain funding first (or in a fiscal year). Turnaround time for funding can be up to two years from the initial request.

2 Implementation Costs

Table IX-1 represents the incremental cost savings, while Table IX-2 includes the incremental cost to all affected transit agencies for ZBuses. The incremental cost represents the cost of a ZBus over the cost of a diesel bus. Delaying the current purchase requirements and including an Advanced Demonstration prevents an expenditure of over $59 million dollars from 2008 through 2012 (including estimated infrastructure costs).

Table IX-1: Cost Savings of the Proposed Regulation Compared to the Existing Regulation

Year	Scenario 1	Scenario 2	Scenario 3
2008	$19,000,000	$19,000,000	$19,000,000
2009	($1,900,000)	($1,900,000)	($1,900,000)
2010	$34,300,000	$25,300,000	$29,500,000
2011	$7,800,000	$36,600,000	$36,600,000
2012	$0	$9,000,000	$4,800,000
2015	$0	$0	$0

As shown in **Table IX-1**, during the current regulation, 11 buses would have been purchased in 2009. The proposed amendments require at least a 12 bus demonstration. Therefore in 2009 an additional cost of $1.9 millions is shown**.**

Table IX-2: Cost of Regulation Scenarios

Year	Existing regulation	Scenario 1	Scenario 2	Scenario 3
2008	$19,000,000	$0	$0	$0
2009	$20,900,000	$22,800,000	$22,800,000	$22,800,000
2010	$34,300,000	$0	$9,000,000	$4,800,000
2011	$39,850,000	$32,050,000	$3,250,000	$3,250,000
2012	$39,900,000	$39,900,000	$30,900,000	$35,100,000
2015	$58,500,000	$58,500,000	$58,500,000	$58,500,000
2020	not under regulatory mandate	$44,300,000	$44,300,000	$44,300,000
2023		$35,550,000	$36,150,000	$36,150,000

Table IX-2, the incremental cost of the Advanced Demonstration is approximately $23 million for the diesel path transit agencies and varies between $5 million and $9 million for alternative fuel path transit agencies, depending on the demonstration option

selected. In addition, alternative fuel path transit agencies will also incur infrastructure costs to implement the Advanced Demonstration. Diesel path transit agencies will be able to utilize established infrastructure although additional infrastructure could be required.

The cost of purchasing the buses for the purchase requirement for all transit agencies starting in 2011 will range from $32 million starting in 2012 to $59 million in 2015. The increase in total expenditure is caused by the growth in the transit bus fleet and the addition of the transitional transit agencies into the purchase requirement. Variations from year to year are attributed to transit agency purchase cycle and the age of the fleet.

Infrastructure costs were not included into the annualized cost of the proposed regulation or the current regulation. These costs were not included since it is difficult to determine the number of stations, station size, type of infrastructure, and when they would need to be built for each transit agency. Transit agencies entering into the purchasing requirement later might end up only needing a small station able to handle 20 fuel cell buses, while an agency like MTA will need infrastructure capable of handling more than 200 fuel cell buses, perhaps at several yards.

Only two hydrogen fuel stations capable of fueling urban fuel cell buses have been built in California: staff does not believe that these current infrastructure costs are appropriate for use in projections. VTA's infrastructure costs included a semi-permanent hydrogen station able to service between 15 and 20 buses, a new bus wash and retrofitted maintenance facility, at a cost of $4.4 million[7]. AC transit put in place a hydrogen fueling station capable of servicing five to six buses per day for approximately $4 million, and retrofitted a diesel maintenance bay and bus wash for $1.2 million, bringing the total to $5.2 million dollars[19]. Using this information, the cost of infrastructure is around $300,000 to $900,000 per bus. This cost is comparable to infrastructure for electric trolleys, another zero-emission technology, which is approximately $800,000 per trolley bus. Several projects are proposed throughout the world and these costs could be more appropriate to determine the future infrastructure costs, unfortunately this information is considered confidential.

Costs for hydrogen infrastructure are not comparable with either CNG or diesel infrastructure for many reasons. CNG and LNG fueling stations can serve up to 250 buses per day and cost between $23,000 and $39,000 per bus, respectively[23]. While, current hydrogen stations are only intended to service between 6 and 20 fuel cell buses. Hydrogen stations are also currently being used for testing and research purposes. Transit agencies as well as energy providers are willing to invest relatively larger sums of money in order to expand their understanding of hydrogen refueling technology and interface. Additionally, prototype and demonstration phases are inherently more expensive than commercial products. Staff expects costs for hydrogen fueling stations to decrease and the number of buses serviced to increase over time as more and more demonstrations are executed. However, unlike electric trolley bus, CNG, and LNG infrastructure, hydrogen infrastructure is still in its development stages, and therefore

more expensive. Staff anticipates that infrastructure costs will decrease as the technology for producing and dispensing hydrogen evolves.

In addition, fuel cell bus providers and transit agencies expect the fuel cell buses to eventually have reduced operating and maintenance costs[4]. Initial fuel economy values from the current AC Transit operations indicate a 100 percent fuel economy improvement compared to diesel. Costs per kilogram of hydrogen are expected to decrease as production processes are optimized, while diesel costs are rising yearly as oil sources are depleted. Hydrogen, a renewable resource, can be produced from a variety of different feedstock. UTC predicts fuel cell bus operation costs per mile to drop below diesel and CNG to thirty cents per mile[4]. Maintenance and operation costs of the mature hybrid fuel cell system are expected to be reduced relative to electric trolley buses, which have proven to be less in comparison to diesel buses.

The cost estimates are not indicative of the actual direct cost to transit agencies. Transit agencies typically receive federal and regional funds for the acquisition of buses and implementing alternative fuel infrastructure. The FTA funds 80-percent of the cost of a diesel bus and 90-percent of the incremental cost of an alternatively fueled bus. In addition, currently proposed federal legislation would provide 100 percent of the incremental cost of hybrid buses. The majority of the cost of buses is covered through federal co-funding; however, the total amount of federal funding is limited. The distribution of the federal funds is administrated by regional transit commissions. Funding is also available for infrastructure, however, the amount of federal and State co-funding for alternative fuel infrastructure has varied.

I Cost to Individuals

Raising fares is one of the few ways transit operators can raise revenues. However, fare box revenues represent a minority of operating expenses, and staff believes, based on discussions with transit operators, that they are rarely used for capital expenditures. In 2005, the average operating revenue from fares from transit agencies operating at least 100 urban buses was 31.75 percent[32]. Staff was unable to provide a reasonable estimate of potential costs to individuals because of several factors, including monthly passes and discounts on ticket books with multiple tickets. Therefore, we cannot predict if or how transit agencies would raise fares.

J Benefits

1 Cost-Effectiveness of Proposed Regulation

Based on costs presented by fuel cell, chassis, system integrators, and transit operators for costs of implementing ZBuses staff determined that at least for the early years of the program the dollars spent per ton of pollutant reduced under the ZBus program will be

[32] ARB. January 7, 2005. Staff Report: Initial Statement of Reasons. Proposed Modifications To The Fleet Rule For Transit Fleet Vehicles.

much higher than for typical ARB regulatory measures. Staff estimated the initial cost effectiveness of the proposed regulation to be $380 per pound of NOx. Staff anticipates the actual cost per pound to be lower, since this cost does not include life-cycle cost savings. In addition, this value does not include funding received from any government funding sources, such as the Federal Transit Administration (FTA).

Although the initial purchase costs may still be higher than conventional diesel and alternative fuel bus technology, the price is more comparable to an electric trolley bus. As technology is optimized, fuel cell bus operation and maintenance costs are estimated to be in line with electric trolley buses, and significantly lower than diesel and alternative fuel buses. When incorporating these factors along with additional improvements to fuel cell technology, staff anticipates that life cycle costs will decrease the cost per pound of emission reduced. The Board has confirmed in previous regulatory decisions, zero emission vehicle programs are an essential component of the State's long-term air-quality strategy. This regulation provides a necessary avenue to bring this technology to the market.

K Potential Negative Impacts

There is a potential for a decrease in the emission benefits from years 2008 through 2017. However, there may also be a potential increase in the emission benefits from 2018 and beyond relative to keeping the existing regulation. However, staff does not expect ZBus technology to be cost effective in time for the existing purchase implementation date. Therefore transit agencies, in order to comply with the purchase regulations, may have to reduce the number of new buses acquired annually and thereby keeping older higher emitting buses in operation longer.

L Incentives and Early Implementation

Incentive programs have the ability to prompt emissions benefits early or beyond those required by regulations. California has the largest incentive program in the nation, with over $140 million available each year through State and local funds. Even at this level funding is far from sufficient to pay for all the reductions needed to provide clean air. Reductions required by regulations, and funded by owners of the affected equipment, will still provide the majority of emission reductions.

Currently, incentive programs, such as the Carl Moyer Program, provide modest funding for fuel cell projects[33]. With the adoption of the proposed regulation, most of the incentive projects for zero emission buses would no longer be eligible for funding. Fleets that demonstrate full compliance with their fleet-average and zero emission bus requirements would be eligible for incentive funds to further reduce emissions. Eligible projects would include electric trolleys, fuel cell buses, and fuel cell hybrid electric buses.

[33] ARB. January 6, 2006. The Carl Moyer Program Guidelines, Approved Revision 2005.

X ISSUES

Over the course of development of this proposal, staff has met many times with various stakeholders and received written and verbal comments. Although staff has considered each comment, not all issues could be resolved. Following is a discussion of major outstanding issues.

A Purchase requirement should be delayed until 2014 for diesel path transit agencies and 2016 for alternative fuel path transit agencies in order to ensure that cost and performance targets are met.

Staff has included a provision that allows the Executive Officer to reduce the ZBus purchase requirement, if performance and cost goals are not met. Staff believes that with this provision, the regulation provides assurances to the transit agencies that the technology will be commercially viable when the 15 percent purchase requirement is implemented.

B Alternative Fuel Path Transit Agencies should not be required to conduct an Advanced Demonstration

Staff has compared the alternative fuel path transit agencies costs for switching to alternative fuel buses and balanced that with the costs the diesel fuel path transit agencies have incurred on the zero emission initial demonstration program. Staff determined that emission reductions were gained in the early years from transit agencies on the alternative fuel path, however, the information gained from the diesel path transit agencies demonstrations to move buses to a zero emission status is just as valuable. Diesel path transit agencies have implemented advanced diesel emission reduction technologies on existing fleets. Since 2000, the transit agencies affected by the ZBus regulation have made significant upgrades to meet the necessary requirements in the Fleet Rule for Transit Agencies[1]. For each demonstration, the diesel path agencies have paid over $5 million per fuel cell bus including infrastructure, while, the alternative fuel path agencies have paid close to $32,000 per bus. Unlike the diesel path projects, the alternative fuel path transit agency projects were able to qualify for Carl Moyer funding to replace their fleets with CNG buses[33]. For these reasons, staff proposes that distinction in how the two paths are treated under the ZBus regulation be revised and that the alternative path transit agencies be given the option to participate in the Advanced Demonstration or align the purchase requirements with the Diesel Path Transit Agencies.

C Buses shorter than an Urban Bus should be included as Zero Emission Buses

Staff was asked to consider whether smaller, battery dominant, fuel cell buses of approximately 22 foot length could be considered to be urban buses. Staff reviewed this option and determined that this type of bus would not be deployed in typical urban

bus service. In addition, the technology and infrastructure requirements for the operation of shorter buses are sufficiently different to minimize the technology transfer to urban buses. The transit regulation was intended to reduce the emissions from the predominant type of transit vehicle in use, the “urban” bus. In addition, no transit agency indicated that they would be inclined to replace urban transit buses with shorter buses. Therefore staff did include shorter, battery dominant, fuel cell buses as a means to meet the purchase requirements of the regulation.

XI ATERNATIVES AND RECOMMENDATION

No alternative considered by the ARB would be more effective in carrying out the goals previously endorsed by the Board in the 2000 regulation than the proposed amendments, nor would any alternative be both as effective and least burdensome to affected private persons than the proposed amendments. The following options were considered in reaching this conclusion.

A Alternatives Considered

During the regulatory development process, ARB staff presented a variety of proposals that were similar in structure to the current proposal including:

- Non Urban Zero Emission Buses
- Fleet-Average Standards
- Near-Zero Emission Requirements
- Earlier Zero Emission Requirements dates
- Earlier Advanced Demonstration dates

Each of the elements noted was considered both independently and in combination.

B April 2006 Draft Proposal

In April of this year staff first provided, in a formal presentation, the requirements of the Advanced Demonstration concept. In general, transit agencies were supportive of the concept but found staff's requirements regarding multi transit agencies demonstrations too prescriptive to the participating agencies. In addition, while the proposal achieved greater emission reductions; staff believes that the risk of potential negative economic impact of that proposal was too high. Without the executive officer discretion clause, the proposal would have set firm purchase requirement implementation dates that could have required reviews and revisions. The current proposal provides more flexibility and sets a more appropriate balance between technical feasibility and cost to affected industries and transit agencies.

C No Amendments to the ZBus Purchase Requirements

Not amending this regulation would have the effect of requiring the purchase of ZBuses in California from 2008 through 2015 by transit agencies at a volume of more than 200 urban buses. ZBus technology has not demonstrated reasonable cost or durability for this level of integration into the transit bus fleet. California's regulations for transit agencies and urban buses are innovative and go beyond the federal requirements for urban buses. At the time they were adopted, it was anticipated that changes could be necessary based upon the state of the technology. Not amending this regulation would also result in higher emissions than the proposal, because the costs of the ZBus would force the transit agencies to extend the life of older higher emitting diesel buses due to costs associated with the ZBus technology.

Since the original rule adoption in 2000, many transit agencies have installed natural gas refueling infrastructure and purchased alternative-fuel urban buses; re-powered diesel engines to engines meeting cleaner exhaust emission standards; installed particulate filters in diesel engines; and experimented with developing technologies, such as hybrid-electric engines and cleaner fuels. Many of California's transit agencies continue to take on the challenge to be innovators and incubators for advanced technologies. Not adopting these amendments would hurt the continuing efforts to advance innovative technologies needed to meet future emission objectives. Staff does not recommend the Board endorse the "no change" alternative.

D Eliminate Zero Emission Bus Requirement

Despite the achievements in motor vehicle emission reductions to date, the vast majority of Californians live in areas of the state that still do not meet State or federal health-based ambient air quality standards. The ZBus technology is a vital component of ARB's strategy to pursue emission reductions from all feasible sources in order to continue our progress toward clean air and to meet and sustain air quality goals. While the goals of the 2000 regulation have not been demonstrated, progress has been made and much has been learned about fuel cell bus technology. Additionally, the momentum around the world to demonstrate and incorporate fuel cell buses into urban transit fleets indicates that abandonment of the ZBus requirement would not be appropriate.

E Conclusion

Having considered all of these alternatives, staff concludes that the proposed amendments to the regulation are the most appropriate to achieve feasible and beneficial implementation of ZBus technology
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XII SUMMARY AND STAFF RECOMMENDATION

A Summary of Staff's Proposal

As presented in the previous sections, the ARB staff's proposal is designed to continue placements of ZBuses in California's urban transit fleets through technology demonstration and measured introduction of purchase requirements. ARB staff acknowledges that the 2006 rulemaking is a "technology-forcing" regulation. All indications point to the technology becoming feasible and cost effective. However, since the performance and cost effectiveness of the technology has yet to be demonstrated staff is including the Executive Officer discretion clause. The staff's proposal includes the following:

- Add an Advanced Demonstration for the diesel path transit agencies in 2009, and an optional demonstration for the alternative fuel path transit agencies in 2010;
- Postpone the ZBus requirement by three years for diesel path transit agencies, two years for alternative fuel path transit agencies in the Advanced Demonstration, and one year for those alternative fuel path transit agencies choosing not to participate in the demonstration;
- Include an Executive Officer Discretion clause that can be used to determine the status of the technology, and reduce the percentage of the purchase requirement if performance goals are not met.

B Staff Recommendation

ARB staff recommends the Board adopt the proposed amendments to sections 2023.1, 2023.3 and 2023.4, title 13, chapter 1, article 4, CCR, in its entirety. The regulation is set forth in the proposed regulation order in Appendix A.

No alternative considered by the agency would be more effective in carrying out the purpose for which the regulation is proposed or would be as effective as or less burdensome to affected private persons than the proposed regulation.

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XIV APPENDIX A: Proposed Regulation