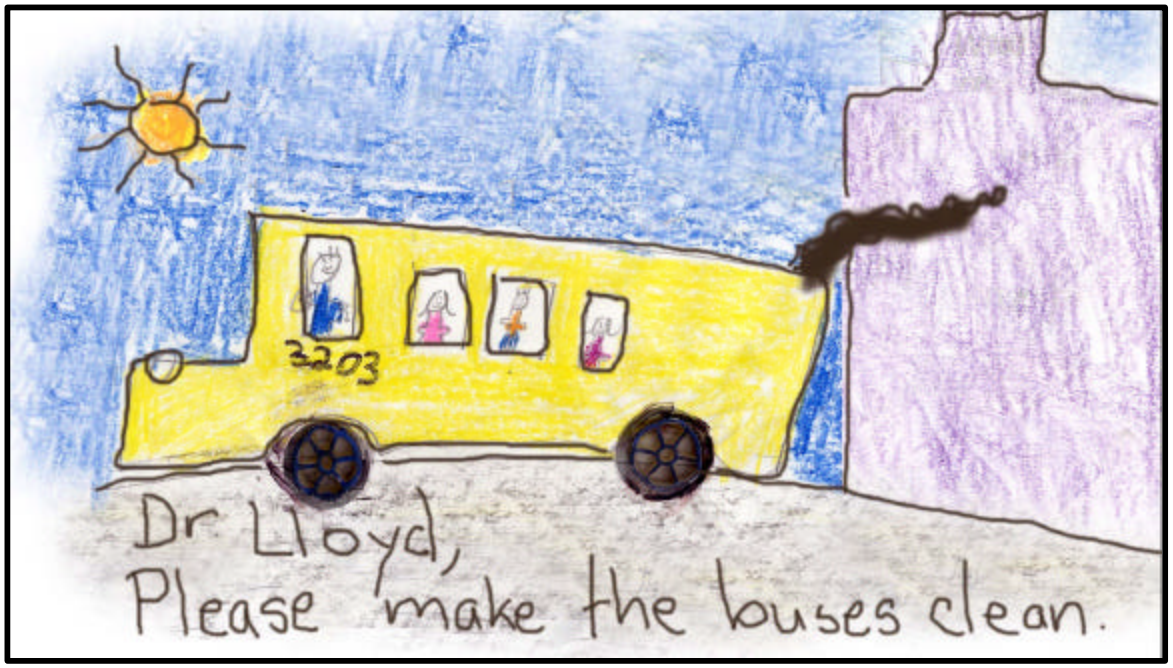
State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

LOWER-EMISSION SCHOOL BUS PROGRAM



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EXECUTIVE SUMMARY

The Air Resources Board's (ARB or Board) mission is to provide clean, healthful air to California's residents, and to protect those most vulnerable to the harmful effects of air pollution. To aid in this mission, Governor Gray Davis has allocated $50 million for the Lower-Emission School Bus Program – a program designed to reduce school children's exposure to both cancer-causing and smog-forming pollution. The ARB approved guidelines to implement this program for purchasing new, lower-emitting school buses, and for retrofitting buses with particulate filters to reduce particulate emissions. The program will fund the purchase of about 350 new buses and 2000 particulate filters for diesel school buses.

In developing the proposed guidelines, the ARB staff worked extensively with the California Energy Commission (CEC), the California Highway Patrol, the State Department of Education, school districts, and local air quality and air pollution control districts. Environmental organizations, engine and retrofit device manufacturers, school bus vendors, school transportation officials, and other concerned constituencies also provided valuable input to program development.

The program will introduce new engine and aftertreatment technology as well as cleaner fuels. The program provides funding for both new alternative fuel school buses and associated infrastructure, and new intermediate emission diesel engines. A significant component of the program is the retrofit of 2000 buses with diesel particulate filters, which will significantly reduce emissions from the in-use fleet. Both the new diesel buses and the particulate filters require the use of low-sulfur diesel fuel.

The Lower-Emission School Bus Program significantly benefits California school children. It benefits children's health by reducing their exposure to toxic and smog-forming pollution. It also provides new buses to cleanly and safely transport our children to school.

I. INTRODUCTION AND SUMMARY

Introduction

Governor Gray Davis allocated $50 million in the 2000-2001 fiscal year budget to the California Air Resources Board (ARB or Board) for a Lower-Emission School Bus Program. The primary purpose of the program is to reduce school children's exposure to both cancer-causing and smog-forming pollution. As called for in the final state budget, the program will provide grants to school districts to reduce pollutant emissions from school buses in two different ways. Part 1, the Lower-Emission School Bus Replacement Program, is designed to replace older, in-use, high-polluting diesel school buses with lower emission new buses. Part 2, the School Bus PM Retrofit Program, is designed to substantially reduce particulate matter (PM) emissions from in-use diesel school buses.

Guidelines for both program components are contained in this document. The CEC will administer Part 1, the Lower-Emission School Bus Replacement Program, but may delegate implementation to local air districts in some cases. Part 2, the School Bus PM Retrofit Program, will be administered by air districts that choose to participate. All school districts will be notified of opportunities to participate in the programs. The ARB will monitor the ongoing implementation of both program components and assist where needed.

The funds for program implementation need to be allocated this fiscal year. In addition, it is a statewide priority to reduce the harmful emissions from older buses as expeditiously as possible. A demanding schedule for implementation, as shown on the timetable, has been set. The ARB, the CEC, and air districts are committed to the prompt, successful implementation of this program.

Summary of the Program

The primary goal of the Lower-Emission School Bus Program is to reduce school children's exposure to both cancer-causing and smog-forming pollution. Through a combined approach of replacing and retrofitting older, high-polluting school buses, the program will reduce emissions of both particulate matter (PM) and oxides of nitrogen (NOx).

The program contains two components: 1) a school bus replacement and infrastructure component; and 2) a PM retrofit component for diesel school buses. Chapter Three of this report describes the criteria for implementing the school bus replacement and infrastructure program. Chapter Four of this report describes the criteria for implementing the PM retrofit program. There is a total or $50 million for the combined program, with $37.5 million allocated to school bus replacement and infrastructure projects, and $12.5 million allocated to PM retrofit projects.

The Lower-Emission School Bus Replacement Program

More than 44 percent of California's public school bus fleet is older than 13 years. Twelve percent of this fleet is older than 23 years and was built before federal safety standards went into effect. These older buses were manufactured before more stringent NOx engine standards were implemented and before any California PM engine standards were implemented. Thus, replacing older school buses will result in improved public health and safety.

There is $37.5 million allocated for this program component. Of this funding, $25 million is allocated for new alternative fuel bus purchases and associated infrastructure; the remaining $12.5 million is allocated for new diesel-fueled bus purchases. About 350 new buses can be funded. The CEC's successful experience administering its Safe School Bus Clean Fuel Efficiency Demonstration Program makes it eminently qualified to implement this portion of the program. Thus, the CEC will be responsible for distributing the funds to school districts through a grant program. However, at its discretion, the CEC may allow an air district to implement the bus replacement component within the air district's jurisdiction. Such an arrangement will have to meet certain criteria, as specified by the CEC.

Older buses eligible for replacement: The program will provide funding to public school districts (and eligible joint powers authorities) for the replacement of pre-1987 in-use diesel-fueled buses. Public school districts that receive funding will have to replace pre-1977 buses before replacing pre-1987 buses. The replacement of older, pre-catalyst, large gasoline school buses will also be allowed on a case-by-case basis, upon verification by the ARB that the bus qualifies.

Emission standards for new replacement school buses: Two categories of buses will be funded through the program: 1) alternative fuel buses certified to the ARB's optional, reduced-emission NOx standards (2.5 grams per brake horsepower-hour [g/bhp-hr] or lower) with a PM emission level of 0.03 g/bhp-hr or lower; and 2) diesel-fueled buses meeting a 3.0 g/bhp-hr NOx emission level and a 0.01 g/bhp-hr PM emission level. Use of low-sulfur diesel fuel is required.

Infrastructure: In addition to new bus purchases, the program will fund alternative fuel infrastructure based on demonstrated need. Of the proposed $25 million for alternative fuel bus purchases, approximately 10 percent of the funds can be used for alternative fuel infrastructure.

Matching funds: Most of the school districts will be required to provide 25 percent of the cost of a new bus, up to a maximum of $25,000, as match funding. The state will pay the remaining costs, representing a minimum 75 percent contribution to the cost of a new bus. Financially impacted school districts will be required to provide 15 percent of the cost of a new bus, up to a maximum of $15,000, with the state paying the remaining cost.

The School Bus PM Retrofit Program

The ARB has identified PM from diesel-fueled engines and vehicles as a toxic air contaminant. Particulate emissions from existing diesel-fueled school buses can be reduced through the installation of particulate filters. As such, $12.5 million has been allocated to the PM retrofit program component to equip as many as 2000 in-use school buses with particulate filters that reduce PM emissions by 85 percent or more. By providing funds for retrofits, this program can achieve greater PM reductions than a program that funds only new bus purchases.

This program component is structured for implementation by local air districts, with oversight by the ARB. Air districts will apply directly to the ARB for funds to implement the program; in turn, air districts will award grants to public school districts.

Eligible school buses: This program component will provide funding to public school districts (and eligible joint powers authorities) for the retrofit of 1977 and newer model year in-use diesel-fueled buses. The retrofit program will also fund the retrofit of school buses owned by private transportation companies that provide transportation services, under contract, to public school districts.

Funding: The PM retrofit program will pay the full cost of the purchase and installation of a particulate filter, estimated to be about $6000. Some manufacturers are also demonstrating retrofit devices that provide a 15 percent NOx reduction, in addition to the program's required 85 percent PM reduction. The ARB estimates the cost for these retrofit devices at around $7500 each; these devices will be evaluated for inclusion in the retrofit program. In addition to funding the retrofit device cost and installation, the program will provide $500 for the incremental cost of low-sulfur diesel fuel (maximum 15 ppm sulfur content) that is required for use in buses retrofitted with PM filters. The ARB staff believes this level of funding will cover most, if not all, of the associated incremental fuel cost.

Emission Benefits

The ARB and local air districts recognize that PM emissions from diesel-fueled engines and vehicles are a serious public health concern, particularly for school age children who are more susceptible to its harmful health effects. When implemented, the Lower-Emission School Bus Program will provide California's school children with less polluting, and in many cases, safer school transportation. The ARB staff has estimated the emission benefits attributable to each program component. The staff estimates that the Lower-Emission School Bus Replacement Program will reduce NOx emissions by approximately 870 tons and PM emissions by 73 tons from 2001 through 2015. For the School Bus PM Retrofit Program, the staff estimates that PM will be reduced by approximately 150 tons from 2001 through 2010. To the extent that air districts fund retrofit devices that also achieve NOx reductions, the retrofit program component could also achieve NOx benefits.

Timetables for the Lower-Emission School Bus Program

An overview of the timetables for the two elements of the Lower-Emission School Bus Program is shown below. Dates shown are the final dates for execution of the designated activities

Lower-Emission School Bus Replacement Program

December 7, 2000	ARB Board acts on guidelines
June 1, 2001	School districts' application deadline for replacement buses
September 15, 2001	Buses ordered from vendors
June 1, 2002	All new buses delivered and infrastructure completed
September 1, 2002	Final reports due to ARB and CEC

School Bus PM Retrofit Program

December 7, 2000	ARB Board acts on guidelines
July 15, 2002	Unencumbered retrofit funds reallocated
September 15, 2002	Air districts award any additional funds
September 1, 2003	Final report to ARB on use of funds

II. NEED FOR THE PROGRAM

A. Background

The ARB's mission is to provide clean, healthful air to California's residents, and to protect those most vulnerable to the harmful effects of air pollution. To aid in this mission, Governor Gray Davis has allocated $50 million for the implementation of the Lower-Emission School Bus Program – a program designed to reduce school children's exposure to both cancer-causing and smog-forming pollution. Environmental organizations, state legislators, the CEC, school district associations, ARB and many other stakeholders supported this effort to accelerate the clean-up of school bus fleets throughout California.

B. School Buses in California

During the last eight years, California school districts have purchased approximately 340 new school buses per year of all sizes and fuel types. In California, school buses are designated either as Type 1 (seating capacity is 16 or more) or Type II (seating capacity is no more than 20 occupants and the bus is under a 10,000 pound gross vehicle weight rating). Fuels used in school buses include gasoline, diesel, compressed natural gas (CNG), liquefied natural gas (LNG), electricity and propane. Diesel, however, is by far the most common fuel used today in school buses. To date, alternative fuel school buses have primarily been funded through state and local incentive programs, such as the CEC's Safe School Bus Clean Fuel Efficiency Demonstration Program and local air district programs. Currently, there are about 600 alternative fuel buses in California's school bus fleet.

The emissions calculations for year 2000, California EMFAC2000 version 2.02m, include emissions from school buses of model years 1965 to 2000, and both Type 1 and Type 2 buses. These calculations include 2400 gasoline buses without catalytic converters, 5000 with catalytic converters, and over 21,000 diesel buses, for a total of about 28,700 school buses statewide. Maximum total emissions from these buses are estimated to be 2.37 tons per day (t/d) reactive organic gases, 51.9 t/d carbon monoxide, 16.2 t/d of NOx and 0.44 t/d of particulate matter.

C. Need for Reductions of PM and NOx

School buses operate in close proximity to students, teachers and neighbors. Many schools provide bus services in heavily populated areas. Older, diesel-fueled school buses often emit high levels of both PM and NOx. This program will reduce emissions by replacing pre-1987 buses and by installing PM retrofit devices on diesel buses for which ARB-certified PM retrofit devices are available. The retirement of pre-1977 buses has been designated a priority because these buses are high polluting and because federal safety standards for school buses did not take effect until 1977.

PM and NOx are the pollutants of most concern with heavy-duty diesel engines. School buses are generally powered by diesel engines regulated through emission standards for heavy-duty truck engines (as opposed to emission standards for urban bus engines). The NOx emission standards for heavy-duty engines were considerably less stringent in the mid-1980s. Moreover, the NOx emissions from these older engines still in use are likely higher than original certification standards due to engine deterioration. Particulate matter emissions were unregulated until 1987.

Significantly cleaner engines are now available and can be deployed to reduce emissions. Today, all new engines used in heavy-duty trucks and school buses must be certified to mandatory NOx and PM emission standards of 4.0 grams per brake horsepower-hour (g/bhp-hr) and 0.10 g/bhp-hr, respectively. Some engines – mainly natural gas engines – are already certifying to the ARB's optional, reduced-emission NOx standards of 2.5 g/bhp-hr or lower. These natural gas engines have also demonstrated PM emission levels of 0.01 to 0.04 g/bhp-hr during engine certification testing. PM emissions from in-use natural gas urban transit buses are also substantially lower than emissions from in-use diesel urban transit buses. Currently, there is insufficient in-use test data for school buses to determine if the same is true for these vehicles. In addition, one engine manufacturer has developed a heavy-duty diesel engine that may be used in school bus applications that tests at emission levels of 3.0 g/bhp-hr NOx and 0.01 g/bhp-hr PM. This engine's low PM emissions are achieved with a PM filter. This particular engine is discussed further in Chapter V.

1. Ozone

Ozone, or smog, is created by the photochemical reaction of NOx and hydrocarbons. It causes harmful health effects ranging from eye irritation, sore throats and coughing, to lung damage, cancer, and premature death. People with compromised respiratory systems and children are the most severely affected; however, even healthy children and adults who play or exercise outdoors are at risk. NOx emissions also contribute to the formation of secondary PM. While California has made significant progress in reducing ozone, additional measures, such as this voluntary school bus program, are needed to further reduce NOx emissions.

2. Particulate Matter

This program will provide dual PM emissions benefits. It will reduce the public's direct exposure to toxic diesel engine PM emissions, and will help in the effort to attain the federal and state ambient air quality attainment standards for PM.

Particulate matter has been linked to a range of serious health problems. Particles are deposited deep in the lungs and can result in increased hospital admissions and emergency room visits; increased respiratory symptoms and disease; decreased lung function, particularly in children and individuals with asthma; alterations in lung tissue and respiratory tract defense mechanisms; cancer and premature death. Children, with their growing lungs and faster respiratory rates, are even more susceptible.

In August 1998, the ARB identified PM emissions from diesel-fueled engines as a toxic air contaminant. In fact, several studies have confirmed that the cancer risk from diesel particulates is greater than the risk from all other identified toxic air contaminants combined. It is the ARB's goal to protect public health by reducing exposure to diesel PM emissions, and it is good public policy to reduce these emissions as quickly as possible, especially from school buses.

Diesel-fueled vehicles operating in heavily congested urban areas are a key source of direct public exposure to toxic diesel particulates. In September 2000, the ARB adopted the Risk Reduction Plan for Diesel-Fueled Engines and Vehicles. This comprehensive plan calls for the retrofit of all diesel engines by 2010 to reduce emissions of PM. This is a necessary step to reduce the cancer risk for the residents of California. Regulations to retrofit transit buses are already in place and requirements for other categories of vehicles will soon be proposed.

3. Other pollutants

Diesel engines have relatively low emissions of carbon monoxide (CO), hydrocarbons (HC) and carbon dioxide (CO2). CO emissions create "hot spots" that affect public health, although nearly all areas of California are in attainment for CO. Emissions of HC are important because, in combination with NOx emissions, they contribute to ozone. CO2 is a greenhouse gas that contributes to global warming.

D. Need for Safer Buses

Pre-1987 buses are high-emitting and thus eligible for replacement under this program. However, buses built before 1977 predate federal safety standards and therefore are particularly important to replace. Where school districts have both pre-1987 and pre-1977 buses, the pre-1977 buses must be replaced first.

E. Need for Funding

There are thousands of older, high-emitting school buses on the road in California. These buses have remained in service simply because school districts lack the funds to replace them. Specifically, there are about 6600 pre-1987 school buses in operation throughout California. Of these, about 1900 were built before the 1977 model year. This demonstrated need is why Governor Davis allocated $50 million to accelerate school bus clean up.

About 900 school districts in California operate their own school buses. Other school districts contract with private transportation providers. School transportation services must be subsidized by school district general funds; few districts charge bus riders. There are insufficient special state or local funding sources designated for this non-mandated service so it must compete for both capital and operating funds with mandated school district responsibilities.

Katz/CEC School Bus Program

The Katz Safe School Bus Clean Fuel Efficiency Demonstration Program was established by Assembly Bill 35 (Katz, Statutes of 1988, Chapter 1426). The program conducted by the CEC funded school buses that met all applicable Federal Motor Vehicle Safety Standards. A total of 826 buses was purchased in the program's four phases from 1988 to 1999. Alternative fuels powered approximately half of these buses. There are no more funds available for this program.

Small School Districts/CDE

The Small School District Bus Replacement Program, conducted by the California Department of Education, provides funding for the replacement of school buses built prior to April 1, 1977, that do not conform to 1977 federal safety standards. Current fiscal year funding is about $4.2 million; this funding level can purchase about 50 new buses. The program is open to local educational agencies and joint powers agencies that have an average daily attendance below 2501 students. The amount of a grant is based on the most recent contract prices prepared by the California Department of General Services for the same seating capacity as the bus being replaced. Of the funds available, approximately 20 percent are set aside for replacement of special education buses and 25 percent for replacement based on the condition of the bus.

Air Quality Incentive Funds

A few school districts have secured air quality incentive funds from local air districts through competitive programs. In these cases, the air districts co-fund the purchase cost of low-emitting CNG buses and infrastructure. Air districts have also funded a few electric school bus projects. However, most air quality incentive funds offer only incremental funding, the difference in cost between a new diesel bus and a new CNG bus, or less. This is not adequate co-funding for many school districts. Also, school bus replacement projects are generally less competitive than other heavy-duty clean-up projects because school buses travel fewer miles per day. Consequently, staff is proposing to provide more than the incremental cost in Part 1, the School Bus Replacement Program.

The CEC has completed the Katz program; the Small School District Bus Replacement Program only replaces about 45 buses per year, and school buses generally have a difficult time qualifying for air quality incentive funds because of their lower mileage. While these programs have provided some funding for new school buses, the program proposed here is vitally needed to continue and expand the upgrading of California’s school bus fleet.

The current lack of funding also inhibits school districts from retrofitting their existing fleets of diesel school buses. Because most school districts cannot replace all their older buses but want to run cleaner buses, Part 2, the School Bus PM Retrofit Program, was proposed. Until now, there has been no opportunity for school districts to purchase

and install on their diesel engines the PM retrofit devices that will substantially reduce the exposure of school children to toxic diesel PM emissions. Manufacturers are currently certifying devices that can substantially reduce toxic diesel PM emissions on a variety of engines at a low cost. In addition, devices that also reduce NOx and contribute to reduced ozone levels are expected to be available soon.

The Lower-Emission School Bus Program offers school districts two ways to reduce health risks to students, teachers, bus drivers and the general public, at a reasonable cost. The $50 million funding available through this program is a start in reaching the long-term goal of replacing or retrofitting all older, high-polluting school buses. To achieve continued progress past the initial 350 school bus replacements and 2000 school bus retrofits, additional funding will be needed.

III. LOWER-EMISSION SCHOOL BUS REPLACEMENT PROGRAM

A. Introduction

What is this program?

The Lower-Emission School Bus Replacement Program has funds available for the purchase of new lower-emission school buses and infrastructure. There is $37.5 million allocated to fund this program. These funds will be distributed through a grant program to school districts for the purchase of new lower-emission school buses and alternative fuel or electric infrastructure.

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Why the focus on school buses?

There are over 25,000 school buses operating in California. About 6600 are pre-1987 model year buses, including about 1900 pre-1977 model year buses. These older buses have high emissions of NOx and PM. As previously discussed, they also were not built to current safety standards. While the continued use of these buses poses public health and safety issues, school districts lack funds to buy new buses. This one-year program won't meet the full need of California's school districts, but it is an encouraging beginning.

What are the goals of the program?

Several important goals are set for this program:

- Replace up to 350 high-polluting buses.
- Reduce criteria pollutants.
- Reduce exposure to toxic diesel particulates.
- Put safer school buses on the road.
- Introduce cleaner fuels: alternative fuels, low-sulfur diesel, or electricity

Why did ARB develop the guidelines?

There is $50 million in ARB's 2000-2001 fiscal year budget for both Part 1 and Part 2 of the Lower-Emission School Bus Program. ARB is charged with implementing the program and developed the guidelines to be used in making the awards to recipients. The ARB governing board approved guidelines for both parts of the program on December 7, 2000. This is currently a one-year program, but it could set a precedent for future school bus programs.

As an air quality agency, ARB's charge is to facilitate funding of projects that will result in the most air quality benefits. NOx and PM are the pollutants of most concern with heavy-duty engines used in school buses. The program is designed to achieve significant emission reductions in both pollutants, as well as meet the other goals of the program.

What is the role of the California Energy Commission?

The CEC has assisted the ARB in developing the Lower-Emission School Bus Replacement Program, drawing on its considerable experience with the previous $100 million Katz school bus program (the Safe School Bus Clean Fuel Efficiency Demonstration Program). At ARB's request, the CEC has agreed to assume the primary responsibility for administering this program and for awarding funds to school districts. This program is designed to be consistent statewide, and the CEC has successfully implemented state school bus grant programs in past years. The schedule for awarding the grants is very tight, and the CEC's strong experience will help to ensure efficient program implementation.

How can air districts participate?

Several air districts expressed interest in administering the Lower-Emission School Bus Replacement Program in their areas. There may be advantages to both school districts and air districts in the complementary administration of the school bus replacement and retrofit programs at the local level. Air districts that wish to directly award the bus replacement funding must apply to the ARB and agree to comply with any provisions required by the CEC. As well, air districts that implement the program will have to demonstrate the ability to meet the very demanding schedule for project funding. The CEC, in consultation with ARB, will ultimately decide where it is in the best interest of the overall program to delegate implementation to air districts. In all cases, local air districts will implement the School Bus PM Retrofit Program, as described in Chapter IV.

What is the responsibility of the school districts?

Each school district will be notified by the CEC or an administering air district of the opportunity to obtain a new, low-emission school bus, the program requirements and the schedule for applying for the funds. Appendix A contains a model school district application to the lower-emission school bus replacement program.

To expedite the purchase of new low-emission buses, including natural gas infrastructure or electric recharging stations, school districts will have to actively participate in the program. After receiving notification from the administering agency, they will have the responsibility of submitting timely applications consistent with the guidelines, identifying match funds, ordering buses, and arranging for infrastructure development.

B. Funding Allocations

How will the $37.5 million in replacement funds be spent?

There is $25 million reserved for buses with engines certified to one of the ARB's optional, reduced-emission standards of 2.5 g/bhp-hr NOx or lower, and to an emissions level of 0.03 g/bhp-hr PM. Most buses that meet this standard currently are fueled by natural gas – no diesel engines currently meet this level. Within this $25 million, approximately 10 percent of these funds could be used for new alternative fuel infrastructure, refueling stations, more capacity at existing stations, and recharging stations.

The remaining $12.5 million is designated for the purchase of the cleanest diesel buses that are available, with engine family emissions limits (FEL) of 3.0 g/bhp-hr NOx and 0.01 g/bhp-hr PM. Currently, one engine manufacturer has indicated its ability to meet this requirement. Although these emission limits are not California certification emission standards, engine manufacturers will be required to certify to the FEL NOx and PM levels and will be contractually required to meet the NOx and PM emission levels.

What is the method for statewide allocation of the funds?

Before proposing the funding allocation presented in Table 1 below, the staff considered several methods of allocating the funds. The two principal methods considered by ARB staff were: 1) to allocate monies based equally on population and the number of pre-1987 or pre-1977 buses in any given area; and 2) to allocate monies based strictly on the general population in any given area.

ARB staff received many comments that incorporating the population of older school buses into the allocation formula would be appropriate, since this program is specifically designed to replace these buses. However, staff is recommending the allocation of monies strictly by population for several reasons. First, placing new, low-emitting buses in densely populated urban areas will reduce exposure to toxic diesel particulates for the greatest number of people. Next, focusing on the number of older school buses is a disincentive to those districts that have spent the money to significantly reduce the number of older buses in their own regions through their own successful school bus replacement programs. Finally, funds for this program come from the state's general fund, which generates revenues based on each region's population. Thus, funds will be returned proportionately to regions in which the funds were generated.

Funding allocations

Table 1 shows air district funding allocations for school districts in 10 regions, based on population. The remainder of the money is an aggregated, or pooled, amount for CEC distribution to school districts in the remainder of the state. These funding allocations are fixed, regardless of whether funds are awarded directly by the CEC or by air districts. The amounts shown are set aside for the various regions, less state administrative costs.

TABLE 1

Tentative Funding Allocation

Region	Funds in millions	Approximate no. of buses
Antelope Valley APCD	0.4	4
Bay Area AQMD	7.3	68
Mojave Desert AQMD	0.4	4
Monterey Bay Unified APCD	0.8	7
Sacramento Metropolitan AQMD	1.3	12
San Diego County APCD	3.2	30
San Joaquin Valley APCD	3.5	33
Santa Barbara County APCD	0.4	4
South Coast AQMD	16.6	155
Ventura County APCD	0.8	7
Other districts	2.8	26
TOTAL	**$37.5**	**350**

Disbursement of funds

The ARB will disburse all school bus replacement funds to the CEC, unless the Commission agrees to delegate implementation to one or more local air districts. The CEC will determine by February 15, 2001, which air districts, if any, are eligible to administer the program and will notify the air districts. Based on the CEC's recommendation, ARB will disburse funds in a single payment to the eligible air districts by March 30, 2001.

ARB encourages the CEC and participating air districts to implement the program quickly, and to have all the funds obligated by agreement by July 1, 2001. Districts must submit a report on project status by July 1, 2001. The report should list projects, state funds obligated to date, any contracts being negotiated, and remaining state funds that have not yet been obligated.

Any funds not obligated under contract by July 15, 2001 may be reallocated by the ARB for disbursement in the designated regions. Should ARB decide not to reallocate

all remaining funds at that time, the ARB reserves the right to require periodic progress reports, and to reallocate unencumbered funds at any time thereafter.

Who can apply for the money?

Public school districts that own their own buses are eligible to receive funding for the replacement of older school buses. Only public school districts in California can apply for funding. Where a joint powers authority (JPA) has been formed by several school districts, and the JPA holds ownership of the school buses, then the JPA is also eligible to participate. School transportation contractors are not eligible applicants. Also, school bus purchases by non-profit agencies, private schools, and other private companies are not eligible for funding.

What will be the school district contribution for buses?

The state program will pay a minimum 75 percent of the cost of a new bus, including state sales taxes and any State Department of General Services (DGS) fees. Most school districts will pay 25 percent of the cost of a bus, with a cap of $25,000 per bus. There is a reduction in the match requirement for school districts severely impacted by the cost of their transportation services. This is defined as those school districts operating more than 20 percent pre-1977 buses and driving at least one of those buses 10,000 miles or more annually. Mileage will be verified through California Highway Patrol records. For eligible school districts, the match requirement is 15 percent of the cost of a new bus, with a $15,000 maximum, providing the new bus replaces a pre-1977 bus. See Appendix D for a list of school districts with more than 20 percent pre-1977 buses.

The source of match funding for bus purchases and infrastructure will have to be documented and attached to the application. If other grant funds, such as air district funds, are being used as match funding, the source of those funds (e.g., motor vehicle registration fee monies) must be stated in the application, along with any requirements in place for the use of those funds. To maximize state funds, Carl Moyer Program funds cannot be used for match funding.

The State Department of General Services (DGS) contract for school buses, (1-00-23-12-01), will be used to determine the allowed priced for a new school bus. Buses do not have to be purchased off the DGS contract. School bus vendors will sell school buses at the state contract prices. School districts are encouraged to purchase buses using the lowest price option. Where school districts choose to order buses that cost more than the state bid list prices, the school districts will be responsible for paying the difference in cost (in addition to the required match). With the exception of the purchase and installation of seat belts, particulate filters, and alternative fuel options, the school district is responsible for the cost of any option not included on the DGS contract.

Each applicant will have to identify sufficient resources to complete the purchase and provide the required fuels. Applications can not be speculative in nature or contingent on the availability of unsecured resources or funds.

What is the process for awarding grants for bus purchases?

The CEC and participating air districts will conduct a non-competitive process of awarding grants for bus purchases, consistent with the guidelines. If the number of applications exceeds the quantity of available funds for any region, a lottery may be conducted to assign awards in that region. The available funding per school district or county could be limited. In determining the funding awards per school district, the ARB encourages maximizing the number of school districts receiving awards, considering individual school district enrollments relative to total enrollment in the geographic area, and the likely availability of low-sulfur diesel fuel.

How will the funding for alternative fuel infrastructure be determined?

1. A number of school districts applying for buses powered by alternative fuels or electricity already have infrastructure in place. Others have access to nearby alternative fuel stations or recharging stations. However, not every school has such resources. Therefore, approximately 10 percent of the lower-emission school bus replacement funds can be used for refueling infrastructure where needed. School districts can request funding to offset the cost of procuring, modifying, or installing new refueling or recharging equipment. This includes expanding the capacity of existing refueling stations, or installing/modifying refueling or recharging equipment. Costs associated with maintenance facility improvements are not eligible for funding.

   School districts will have to estimate the cost of the necessary equipment and installation and include that on the grant applications (See Appendix A). Awards will not exceed, on average, an amount equal to 10 percent of the new bus funding awarded to the applying school district.

   Funding for infrastructure will be available based on demonstrated need. A number of school districts have CNG stations. School districts will have to demonstrate why an off-site refueling station or recharging station cannot be used to fuel their buses.

   If a school district-owned CNG station is required, a slow-fill facility may be funded. This could include a CNG compressor, fueling posts, piping, and other necessary equipment. Improvement in maintenance facilities is not eligible for funding. Upon approval of the administering agency, awarded funding could be used, alternatively, to buy down the cost of a new school district-owned, public access, fast-fill facility.

C. Eligible Buses and Infrastructure

What buses and infrastructure are eligible?

- School buses with a manufacturer's gross vehicle weight rating (GVWR) greater than 14,000 pounds are eligible for funding. These buses all require heavy-duty engines.
- To assure significant emission reductions, the new buses will have to replace an identified, older, in-use diesel or gasoline bus. The new bus must be owned and operated by the recipient air districts for five years of more. Fleet expansion buses are not eligible for funding.
- New heavy-duty buses with engines that run on any fuel except gasoline are eligible if required engine standards are met or exceeded.
- Fueling facilities for alternative fuels and electricity are eligible.

What fuels are eligible?

Buses powered by natural gas, liquefied petroleum gas (LPG or propane), diesel, electricity, methanol, and ethanol fuels are eligible as replacement buses, if other program requirements are met.

Are there fuel availability issues?

There are some fuel availability issues.

- Natural gas is not available in some rural areas.
- Electrical service is available, but electric buses are not widely available.
- Propane used in certified heavy-duty engines is required to be of a higher quality than that required for use in heating stoves, etc. Lack of adequate distribution capabilities for fuel-grade propane has been an issue in northern California. However, the ARB staff is working with the propane industry to address these issues.
- The cost and availability of low-sulfur diesel fuel in small volume orders and rural areas is currently unknown.

Is there an advantage to alternative fuels?

Natural gas is readily available in urban areas of the state. A number of school district governing boards have made the decision to eliminate toxic diesel PM emissions by switching to alternative fuels, most often CNG. Natural gas engines are inherently lower-emitting in both NOx and PM emissions. Some school transportation officials report lower fuel costs and maintenance costs. Most school districts with CNG buses have accessed local and state air quality funds to buy down the costs of the buses and the refueling infrastructure.

Is low-sulfur diesel fuel required in the diesel buses?

Fuel quality is an integral part of a complete emission control system for both gasoline and diesel-fueled vehicles. Although other fuel constituents affect engine-out emissions, fuel sulfur is the single most important constituent for catalyst-based emission control technology. Sulfur in diesel fuel adversely affects the performance of all catalyst-based emissions control technologies. Most advanced catalyzed particulate filters require low-sulfur diesel fuel in order to achieve and maintain high control efficiency. Failure to use low-sulfur fuel may result in damage to the catalyst. The manufacturers of diesel buses with particulate filters or traps specify the use of low-sulfur fuel to assure emission reductions; the filters are generally certified using low-sulfur fuel. This is not primarily an ARB requirement but a function of the design of some of the PM filters on the lower-emitting diesel buses.

Use of diesel fuel with a sulfur content of no more than 15 parts per million (ppm) by weight is required in all funded diesel buses. (Current California diesel fuel has a sulfur content of about 150 ppm; limit is 500 ppm.) A fuel management process must also be in place to prevent mis-fueling of the funded buses (i.e., using conventional diesel fuel that could affect PM filter performance). Low-sulfur diesel fuel works effectively in all diesel engines. In fact, the use of low-sulfur fuel will provide emission benefits from diesel-fueled vehicles without particulate filters, although it is not required to be used in a school district's entire diesel fleet.

Prior to execution of a funding agreement, school districts shall document that low-sulfur diesel fuel will be available at the time of delivery of any new diesel buses and the installation of any PM retrofit devices.

What buses qualify as replaced buses?

As a prerequisite all new and replaced buses will be heavy-duty buses with a GVWR of 14,000 pounds or more. All buses to be replaced will have a current CHP certification and public school buses will be in general use for kindergarten through 12th grade pupil transportation. Then:

- Priority is given to the replacement of in-use pre-1977 model year school buses. First, each new purchase will replace any in-use diesel pre-1977 model year school buses in the given fleet, and the pre-1977 buses will be crushed.
- Next, any pre-1977 heavy-duty gasoline buses that did not include an original equipment catalytic converter will be replaced and the buses crushed.
- Where fleets contain too few or no pre-1977 buses, pre-1987 diesel buses can be replaced. The 1977-1986 model year replaced bus will be crushed, or, alternatively, replace a CHP-certified, in-use pre-1977 school bus in another California bus fleet (not limited to public school bus fleets). Then this replaced bus must be crushed.

- Next, any 1977-1986 heavy-duty gasoline buses that did not include an original equipment catalytic converter can be replaced. The replaced bus will be crushed, or replace a CHP-certified, in-use, pre-1977 school bus in another California bus fleet (not limited to public school bus fleets). Then this replaced bus must be crushed.

Thus, the buses replaced will be the oldest and the highest polluting. These will be the same buses built before 1977 federal safety standards were enacted, or that do not meet more current safety standards. Priority is given to diesel-fueled buses to assure reductions of NOx and toxic PM. However, replacement of pre-1987 heavy-duty gasoline-powered buses without catalytic converters is allowed, with approval. The toxic benzene emissions of these buses are uncontrolled.

D. Award Process

What information does the application require?

In order to determine if the application is eligible for funding, certain information will be required. (See Appendix A for the model school district application.) Required information includes:

- Bus(es) to be replaced: VIN number, ID number, type, make and model year, fuel, total mileage, 2000 mileage, GVWR, and method of disposal.
- Bus(es) to be purchased: Type of bus(es), make and model year, engine size, manufacturer, cost, and assumed date(s) of delivery
- Fuel: Type(s) of fuel needed, availability of refueling capability and delivery of fuel by bus delivery date(s)
- Matching funds: Identification of source
- Alternative fuel and electric infrastructure: Demonstrated need based on accessibility of off-site station; cost of CNG slow-fill equipment; cost of recharging station.

In addition to allowing an eligibility determination to be made, this data will allow the ARB to compute the emission reductions attributable to the school bus replacement program.

Grant applications must include a resolution from the school district governing board (or a duly authorized official with authority to make financial decisions) authorizing the submittal of the application and identifying the individual authorized to submit and carry out the bus replacement project. Applications that are submitted without an authorizing resolution will only be funded if the resolution is submitted by April 30, 2001.

If significant revisions to an application occur before a funding agreement is signed, the date of the revised application is the established submittal date.

How will the awards be made?

School districts will be notified by mail after awards are approved by the CEC or participating air districts. Staff at these agencies will prepare funding agreements that set forth the terms, conditions, and reporting requirements for each grant. All funding agreements shall be signed by July 1, 2001.

The payment schedule will be established in the funding agreement. No funds will be released until the school district and the CEC or participating air district have signed the funding agreement. In general, payment will be made as purchase costs are incurred and documented.

School districts can only incur project costs as of the date of approval by the CEC or participating air district. Neither agency will fund, nor be liable for any portion of, an applicant's cost of preparing and submitting an application.

Arrangements can be made for the CEC or the air districts to issue payment for a bus or infrastructure to vendors due to the requirements of California Education Code, section 41200, et al. (California Proposition 98). CEC will not purchase buses or infrastructure.

Returned funds will be allocated for new bus purchases. Returned funds consist of school bus replacement funds allocated to purchases that are completed under budget or cancelled.

What are the reporting requirements?

Reporting requirements are minimal. All school districts will report to the CEC or participating air districts upon ordering and delivery of bus(es), and contracts let for, and completion of, any funded alternative fuel or electric infrastructure. School districts receiving new buses funded under the program must notify the funding agency when contracts are signed for the purchase of low-sulfur fuel. Any other requirements will be specified in the funding agreements.

E. Emission Benefits

What are the mandatory NOx engine emission standards now?

Truck engines are used in school buses. The current mandatory heavy-duty engine standard is 4.0 g/bhp-hr for NOx. Every new heavy-duty vehicle that goes on the road has an engine that has been certified to that standard, at a minimum, regardless of fuel type.

In 2004, the NOx mandatory heavy-duty standard will drop to 2.5 g/bhp-hr NOx plus non-methane hydrocarbon (NMHC). However, an agreement was reached with most engine manufacturers, and now their 2002 model year heavy-duty engines made

beginning October 1, 2002, will meet that standard. Five engine manufacturers--Mack Trucks, Caterpillar, Detroit Diesel, Volvo, and Cummins--are committed to developing diesel engines that can meet the 2.5 g/bhp-hr NOx+NMHC standard by this early timeframe.

What are ARB optional NOx standards?

In addition to the mandatory emission standards, there are optional, reduced-emission NOx standards. They were adopted by the Board as a way to qualify vehicles for mobile source credits and air quality incentive funding. In general, "low-emission" buses are defined as those buses with engines meeting the optional standards.

The current heavy-duty optional NOx standards are 2.5 g/bhp-hr and lower. At the reduced level, this means a reduction of over 35 percent in NOx emissions every mile the bus is driven. This standard will go down to 1.8 g/bhp-hr NOx+NMHC and lower in October 2002. Natural gas and propane engines are currently certified to the ARB's optional, reduced-emission NOx standards. Some diesel engine manufacturers and aftertreatment device makers are evaluating the feasibility and timing of certifying diesel engines to the optional NOx standard. However, at the time the guidelines were approved, no diesel engines met the low emission levels.

What about engines with an intermediate NOx level?

Representatives of one manufacturer say a diesel engine has been produced for use in school buses that tests at 3.0 g/bhp-hr NOx. At the time the guidelines were approved, the engine was in the demonstration phase and had not been certified to this intermediate NOx level. There is both a federal and state process, engine family emission limits (FEL), for certifying to intermediate levels. Although rarely done to secure eligibility for state grant funds, it is possible for this diesel engine, or other engines, to be certified using the FEL process. To be eligible for funding under this program, diesel engines must be certified to a 50-state or California-only FEL of 3.0 g/bhp-hr NOx. Engines must be certified by April 1, 2001. Running changes to increase this FEL are not allowed.

The state is funding these school buses for their air quality benefit. To prevent double-counting of that benefit, the NOx emission reductions from 4.0 g/bhp-hr to 3.0 g/bhp-hr cannot be counted in the 50-state or California-only averaging, banking and trading (ABT) programs. Neither can they be counted as mitigation required under the federal Consent Decrees or California-specific Heavy-duty Diesel Settlements between the engine manufacturers, the ARB, and the U.S. Environmental Protection Agency. Manufacturers can choose to certify to either the 50-state or California FEL. As a condition of that certification, the engine manufacturer would have to relinquish any and all potential ABT credits and mitigation credits from sale of these engines.

What are the PM engine emission standards?

For PM, the current standard for heavy-duty and medium-duty truck engines is 0.10 g/bhp-hr. The standard is mandatory for all new truck engines. To be eligible for funding under this program, and in addition to the NOx engine certification requirements, diesel engines must be certified to a 50-state or a California-only FEL of 0.01 g/bhp-hr PM by April 1, 2001. Running changes to increase this FEL are not allowed. Consistent with the NOx certification, the manufacturers can choose to certify to either the 50-state or California FEL. As a condition of that certification, the engine manufacturer would have to relinquish any and all potential ABT credits and mitigation credits from sale of these engines.

Currently there is no optional, reduced-emission standard for PM. However, the transit bus rule, adopted by the ARB in February 2000, does contain an optional, reduced-emission PM standard of 0.03 g/bhp-hr or lower for alternative fuel buses. This optional standard will go into effect on October 1, 2002. To be consistent with this transit bus standard, alternative fuel heavy-duty engines in funded school buses will have to be certified at a 0.03 g/bhp-hr PM level or lower. This level will mean a reduction of 70 percent over the ARB's mandatory PM standard for truck engines.

Natural gas engines, and diesel engines with particulate filters, can achieve these levels or lower. At the time the guidelines were approved, the diesel systems had not yet been certified. Diesel engines require the use of low-sulfur fuel to maintain this emission level. Filter-equipped natural gas buses will have even lower emissions of PM. Filters that reduce PM levels by 85 percent or more are required in the recently adopted transit bus rule.

What are the in-use PM emissions?

The emission values discussed above for NOx and PM are certification values. They are emission levels that are achieved by the engine on a laboratory test stand. There is significant evidence for transit buses that once these engines are placed in vehicles, their "on-the-road" PM emissions are significantly different than the certification results. Specifically, the data indicate that real-life PM emissions from diesel transit buses are greater than expected by the certification values, while CNG engines produced significantly lower in-use PM emissions than expected. Consequently, while a diesel and a CNG transit bus engine might have similar PM levels during certification testing, it would not be surprising for the diesel transit bus to have ten times greater PM emissions in actual use.

In-use emissions are significantly related to how a vehicle is used – its "duty cycle." For transit buses, the duty cycle consists of a large number of stops and hard, low-speed accelerations. The duty cycle for school buses does not typically have as extreme accelerations/decelerations as the transit bus duty cycle. At this time, there is insufficient information to determine if there is a significant in-use PM discrepancy with school buses, as there is with transit buses. The ARB staff will be gathering more

information on both the emission levels and the typical duty cycle of school buses. The results of these data will be incorporated into any future programs.

What are the emissions standards?

To give flexibility to the school districts in selecting fuel types, there are two options, with overall limits of $25 million statewide for Option 1 and $12.5 million for Option 2:

Option 1: Heavy-duty alternative fuel engines will have to be certified to the optional 2.5 g/bhp-hr NOx standard and a 0.03 g/bhp-hr PM level or less. At he time the guidelines were approved, only natural gas and propane engines are certified to these levels. Use of these standards makes the school bus program consistent with other state and local air quality incentive programs.

Option 2: Heavy-duty diesel engines will have to certify to a FEL of 3.0 g/bhp-hr NOx, as well as a 0.01 g/bhp-hr or lower PM FEL. The eligibility of lower-emitting diesel buses in the program allows school districts flexibility in selecting the fuels most advantageous to their fleets.

Should there be a mix of natural gas and diesel buses?

Yes. Some school districts are committed to natural gas buses and some to diesel buses. Buses powered by both fuels have advantages. The natural gas engines are certified to ARB's optional, reduced-emission NOx standards, thus contributing to NOx reductions required in many areas of California. In-use PM emissions tend to remain low for the life of the bus. These engines operate on established technology. In many school districts, investments have already been made in refueling infrastructure. At this emissions level, both state and local air quality incentive funds are available.

At this time there are no diesel bus engines certified to ARB's optional, reduced-emission NOx standards. However, manufacturers are working to certify to an intermediate NOx level and a lower emission PM level. Also, having the ability to select different fuels is consistent with the ARB transit bus rule.

As a result, $12.5 million of the $37.5 million bus replacement monies are designated for purchase of these somewhat-cleaner diesel-fueled buses. This will result in as many as one-half of the buses funded through the program being diesel-fueled. Manufacturers will certify the engines to a 3.0 g/bhp-hr engine FEL for NOx and 0.01 g/bhp-hr FEL for PM.

What are the estimated emission benefits of the proposed bus replacement program?

The ARB staff estimates that the School Bus Replacement Program will reduce NOx emissions by 870 tons and PM emissions by 73 tons from the year 2001 through 2015. The emission benefits of "green diesel" engines (i.e. intermediate diesel engines) and

alternative fuel engines are shown in Table 2 below. The analysis shows the emission benefits relative to the baseline if there were to be no lower emission school bus program. The analysis is for $25 million in funding for alternative fuel buses and $12.5 million in funding for diesel buses. The table shows the emission benefits based on a total of 350 new buses purchased.

TABLE 2

Emissions Benefits of School Bus Replacements: Alternative Fuel and Intermediate Emissions Diesel Engines ($25M Alternative Fuel; $15M Intermediate Diesel)			
Fuel	**Number of Buses**	**NOx Benefit (tons)**	**PM Benefit (tons)**
Alternative Fuel	200	520	40
Intermediate Diesel	150	350	33
TOTAL	**350**	**870**	**73**

The analysis was calculated based on actual model year distribution of the current school bus fleet. The fleet emissions were projected over the next 15 years, with a modest baseline turnover rate of slightly over four percent, consistent with our EMFAC 2000 inventory. The analysis is based on certification emission levels, not in-use emissions. For this analysis, a certification emissions level of 0.01 g/bhp-hr PM was used for both diesel and alternative fuel buses. The analysis also assumes current DGS contract price for purchased buses, including intermediate diesel buses with particulate filters.

School buses are driven up to 20 years. Therefore, purchasing new, lower-emitting buses has long term benefits. There are public health benefits to children, teachers and neighbors. Under this program the NOx emissions will be reduced an average of 320 pounds per day and PM emissions an average of 27 pounds per day.

IV. SCHOOL BUS PARTICULATE MATTER RETROFIT PROGRAM

A. Introduction

Governor Gray Davis allocated $50 million in ARB's 2000/2001 budget for the Lower-Emission School Bus Program. There is $12.5 allocated to implement a PM retrofit program. The goal of the program is to retrofit 2000 in-use diesel school buses to reduce school children's exposure to toxic PM emissions. The air districts will administer the program.

School buses remain in use for extended periods of time since they average only about 15,000 miles per year. Therefore, retrofitting existing school buses can provide significant emission reductions for many years. Reductions are significant, cost-effective, and immediate with the use of existing technology.

What are the goals of this program?

Several important goals are set for this program

- Reduce impacts on children's health
- Reduce exposure to toxic diesel particulates
- Retrofit up to 2000 high-polluting school buses
- Reduce PM emissions

Why focus on retrofit of existing school buses?

The main goal of the program is to reduce school children's exposure to diesel school bus PM emissions. Children are exposed to these emissions while waiting for, riding in, or playing near school buses. There are over 25,000 school buses statewide, with over 25 percent of them having very high PM emissions. Funds are not available for immediate replacement of these buses. However, installing diesel particulate filters (PM retrofits) on buses is a highly cost-effective option to immediately reduce children's PM exposure by 85 percent.

This focus on PM retrofits integrates with the comprehensive Risk Reduction Plan for Diesel-Fueled Engines and Vehicles adopted on September 28, 2000, by the ARB. The Plan's target is to reduce diesel PM emissions and the associated health risk by 75 percent in 2010 and 85 percent or more by 2020 by retrofitting every feasible existing diesel engine in the state.

Diesel particulate filters are a mature technology that provides large reductions in PM emissions and exposure. Appendix C of these guidelines describes the operation of these devices and their operating experience. The availability of low-sulfur fuel (maximum 15 ppm sulfur content) now allows the widespread use of these devices in fleet operations. The need to reduce diesel PM emissions combined with the option to use cost effective technology are the bases for PM retrofits under this program. Retrofitting in-use diesel buses is a cost-effective option in addressing the exposure of school children to toxic PM emissions. The average cost of a PM retrofit is small compared to the cost of a new bus; on average one can retrofit about sixteen buses for the cost of one new bus. Also, PM retrofits will provide emission benefits for at least ten years and reduce PM exposure to the general population. Therefore, PM retrofits can maximize health benefits by providing significant long term PM reductions in addition to those reductions resulting from new bus purchases.

How do retrofits fit into ARB's long-term goal to reduce diesel PM emissions?

The ARB identified PM emissions from diesel-fueled engines as a toxic air contaminant in 1998. The Board adopted a diesel risk reduction plan at its September 2000 meeting. Among the measures identified in the diesel reduction plan is a measure to require the retrofit of as many heavy-duty diesel engines as is technically feasible by 2010. Thus, ARB will begin efforts to develop programs and regulations to retrofit all diesel engines with particulate filters by 2010, including diesel school buses.

In February 2000, the ARB adopted a transit bus rule that requires the PM retrofit of diesel-fueled urban buses, phased in from late 2002 through the end of 2008. Diesel buses with the highest PM emissions will be the first buses retrofitted. A retrofit device that demonstrates at least an 85 percent conversion efficiency will have to be installed. Low-sulfur fuel will have to be purchased beginning in July 2002 to assure the durability of the retrofit devices is maintained. The retrofit manufacturers and diesel fuel suppliers have assured ARB staff that both the retrofits and low-sulfur diesel will be available for this program.

What are local air districts doing to reduce PM emissions?

Some local air districts are interested in retrofitting diesel engines to reduce public exposure to harmful PM emissions. Currently, the South Coast AQMD and the ARB are conducting a demonstration program in which several school buses have been retrofitted with particulate filters. Three school districts are participating in this demonstration program in which retrofit devices from several manufacturers are being evaluated for performance and durability. The South Coast AQMD has identified school buses as a category for potential regulation under its 1190 series of fleet rules. At the time the guidelines were approved, a regulation had been proposed for school buses but not yet adopted.

B. Funding Allocations

How much money is available for the retrofit program?

There is $12.5 million allocated for implementation of the retrofit program. Staff estimates that approximately 2000 diesel school buses will be retrofitted with particulate filters at this funding level.

Will the program pay for the full cost of the retrofit devices?

Yes, the program will pay for the full cost and installation of a PM retrofit device. Also, retrofit devices that provide at least a 15 percent NOx reduction and an 85 percent reduction in PM emissions will be evaluated for inclusion in the program.

The program will also pay $500 per each bus that is retrofitted with a particulate filter towards the increased cost of low-sulfur diesel fuel. Staff estimates that this will cover

the incremental fuel cost for about five years, at an estimated incremental cost of 3 to 5 cents per gallon. In areas where the incremental fuel costs may be greater, school districts are encouraged to form consortiums with other school districts, transit agencies, or other agencies to secure volume discounts. The U.S. Environmental Protection Agency is proposing to require the use of low-sulfur fuel (maximum sulfur content of 15 ppm) nationwide starting in 2006, so after 2005 the ARB expects no associated incremental cost for low-sulfur diesel fuel.

The school district will be responsible for obtaining low-sulfur diesel fuel to ensure proper operation of the retrofit devices and assuring that no filter-equipped buses are mis-fueled. Also, the school district will be responsible for minor routine maintenance of the retrofit devices, expected to amount to one to three hours per year.

Who will administer the school bus retrofit program?

ARB will grant awards to the local air districts to implement the school bus retrofit program. Those air districts that want to implement the program will apply to the ARB for funding. The ARB is passing through administration funds to allow the air districts to more easily implement this program.

How will the funds be allocated to the air districts?

Funds are allocated to five large air districts based on population. Each of those air districts is entitled to funds based on the population in its respective jurisdiction. Demand for the retrofits by school districts or school transportation contractors should be estimated, however. Because of the limited amount of funds available for the program, and the relatively small populations in the more rural air districts, the funds are aggregated for the remaining districts. The air districts in this larger region will apply for funding from the "pooled" funds. The total funds available to any air district in the pool will depend on the number of districts applying for funds.

The participating air districts will administer the retrofit program consistent with ARB guidelines. Air districts are not required to provide match funding to implement the retrofit program. Table 3 below shows the estimated allocations for the larger air districts and the available aggregated funds for the remaining air districts to implement a retrofit program. The funding amounts shown include administrative fees for districts to implement the program.

Table 3

Tentative Funding Allocation		
Region	**Funds in Millions**	**Approximate no. of PM Filters**
South Coast AQMD	$ 5.5	884
Bay Area AQMD	$ 2.4	391
San Joaquin Unified APCD	$ 1.2	185
San Diego APCD	$ 1.1	170
Sacramento AQMD	$ 0.4	70
Other Districts	$ 1.9	300
TOTAL	**$12.5**	**2000**

C. Eligibility Criteria

Who qualifies to have their school bus retrofitted with a particulate filter?

California public school districts that directly provide transportation services and joint power authorities (JPA) are eligible to apply for funds to retrofit their diesel-fueled buses. Private school transportation companies that provide transportation services, under contract, to public school districts may also apply for funding.

Are funding recipients required to pay part of the cost of retrofits?

No, the retrofit program will pay for the full cost of retrofits and installation, and $500 dollars for incremental diesel fuel cost.

How does a school district or school transportation contractor apply if it wants to participate in the retrofit program?

Those interested in participating in the retrofit program will apply directly to their local air district for funding for the purchase and installation of particulate matter retrofit devices, plus funding of the incremental fuel cost for low-sulfur fuel.

What type of buses qualify for PM retrofits?

All 1977 and newer model year in-use diesel-fueled buses qualify for retrofits, provided there is a certified retrofit device available for each engine. Both Type I and Type II school buses are eligible. The focus is on retrofitting the highest polluting buses that can be reliably retrofitted with particulate filters.

Beginning with the 1988 model year, the ARB set an emission standard of 0.6 g/bhp-hr PM for heavy-duty diesel engines. The standard was lowered to 0.25 g/bhp-hr in 1991. In 1994, the standard was again lowered to its current level of 0.10 g/bhp-hr. Pre-1987

model year buses are uncontrolled for PM and can have significantly higher PM emission levels. Buses equipped with PM filters under this program will emit at least 85 percent less PM.

Because of the intrinsically lower PM emissions from natural gas buses, these buses are not eligible for retrofits under the proposed program.

What is a particulate filter and how does it work?

Diesel particulate filters are typically designed as a replacement for a vehicle's existing muffler. These devices look similar to current automobile catalytic converters. Exhaust from the engine goes through the diesel particulate filter, where particles are deposited. Elimination of the particles typically occurs by oxidation (combustion) of the particulate matter deposited on the filters. To improve long-term efficiency and durability, the filter should occasionally be removed and cleaned out. For typical school bus operation, this is no more than once every two to three years.

How do we know PM filters will work on school buses?

Throughout the world, thousands of PM filters are already in use on various heavy-duty vehicle applications. For this particular program, PM filters cannot be funded unless certified by the ARB to achieve an 85 percent conversion efficiency. The certification process also requires a complete demonstration of durability and effectiveness, and requires manufacturers to warrant their retrofit devices for 150,000 miles for emissions effectiveness and for 100,000 miles for mechanical performance. Based on current experiences with PM filters, manufacturers' commitments to certify their devices, and the implementation of the ARB's certification procedures, the ARB is confident that PM filters will provide significant reductions, while remaining durable and effective.

To further validate the effectiveness of PM filters, the South Coast AQMD and the ARB are currently conducting a demonstration project for the most common school buses used in California. The project is evaluating retrofit devices from several manufacturers for emissions performance and durability. The ARB is assisting in the emissions testing of several buses to verify the emission control efficiency of PM retrofits in a wide variety of school buses. The buses will operate on their normal routes and data on performance and durability will be collected. The demonstration project will be completed in 2001.

The ARB has also established an In-Use Retrofit Team that can offer technical support to air districts and school districts participating in the school bus retrofit program. The ARB retrofit team will work with the air districts in the implementation of the retrofit program.

What retrofit devices are available?

Diesel particulate filters have been used extensively in both the United States and in Europe in various applications. ARB staff expects manufacturers to certify PM retrofit devices by the time this program is implemented. While retrofit devices may not be available for all model years and engine types right away, the staff expects that enough retrofit devices will be available to ensure the effectiveness of the program. A more detailed discussion on retrofit devices in provided in Appendix C.

It is possible that some qualifying retrofit technologies will provide a NOx reduction, in addition to the PM benefits. The ARB will determine the eligibility of such devices. Such devices may have an additional incremental cost relative to diesel particulate filters. The additional cost of devices that control PM and NOx will be funded by the program.

While the diesel particulate filters provide a significant level of control, they do require properly maintained buses in order to perform effectively. Excessively smoking buses (e.g., those burning excess oil) or engines otherwise in need of repair could damage the filters and are not good candidates for retrofit. Air quality agencies will work with school districts to assure a good vehicle match for retrofit program funds.

Why is low-sulfur diesel fuel required?

Advanced catalyzed particulate filters require low-sulfur diesel fuel to operate properly and achieve an 85 percent or greater PM control efficiency. While the use of low-sulfur fuel also provides benefits in vehicles without particulate filters, for this program, it is only required for those buses retrofitted with a PM filter. A fuel management process must be in place to prevent mis-fueling of the retrofitted buses (i.e., using conventional diesel fuel).

How does low-sulfur diesel fuel differ from the diesel fuel we use now?

Current California diesel fuel has a sulfur content of about 150 ppm; the limit is 500-ppm sulfur by weight and ten percent aromatic hydrocarbon content. Fleets that retrofit their school buses with particulate filters must use diesel fuel with a maximum sulfur content of 15 ppm by weight in the retrofitted buses (low-sulfur diesel fuel). Low-sulfur diesel fuel is not significantly different than the current fuel in any other respect. Therefore, the staff does not expect any adverse impacts on engine performance. This program only requires its use in school buses retrofitted with filters. The low-sulfur diesel fuel enables proper operation of the particulate filter and also provides modest PM emission reductions in vehicles that have not been retrofitted with PM filters.

D. Award Process

What information will the application require?

In order to determine if a particular retrofit application is eligible for funding, certain information will be required. (See Appendix B for the model application for retrofits for school districts and school transportation contractors.)

- Name of school district, JPA or school transportation contractor.
- Bus(es) to be retrofitted with particulate filters: VIN number, model year, total mileage, and engine type, at a minimum
- Fuel: availability of refueling capability and low-sulfur fuel on PM retrofit installation date(s)

In addition to allowing an eligibility determination to be made, this data will allow the ARB to compute the emission reductions attributable to the school bus retrofit program.

Grant applications must include a resolution from the school district governing board (or a duly authorized official with authority to make financial decisions) authorizing the submittal of the application and identifying the individual authorized to submit and carry out the bus replacement project. Applications submitted without an authorizing resolution will be returned to the district and will not be considered until the authorizing resolution is received. Applications from a private school transportation contractor will have to be signed by a company official authorized to apply for grants and must include the names of the school districts served.

If significant revisions to an application occur before a funding agreement is signed, the date of the revised application is the established submittal date.

How will the awards be made?

Applicants will be notified by mail after the participating air district approves the retrofit application. Staff will prepare funding agreements that set forth the terms, conditions and reporting requirements of each grant. All funding agreements must be signed before a purchase order for the retrofits is placed.

The payment schedule will be established in the funding agreement. No funds will be released until the school district or the school transportation contractor and the participating air district have signed the funding agreement. In general, payment will be made on a reimbursement basis as purchase costs are incurred and documented.

Applicants can only incur project costs as of the date of approval by the participating air district. The air district will not fund, nor is it liable for any portion of an applicant's cost of preparing and submitting an application.

Mutually-agreed upon arrangements could be made between school districts and air districts for the purchase of retrofit devices to minimize the financial impacts to schools, due to the requirements of California Education Code, section 41200, et al. (California Proposition 98). An arrangement could be made for air districts to directly purchase retrofit devices from the vendors, as well as pay incremental fuel costs to vendors.

What are the reporting requirements?

Reporting requirements are minimal. All school districts and contractors will report to participating air districts for PM filter purchases. Those receiving funds under the program must notify the funding agency when contracts are signed for the purchase of low-sulfur fuel. All other requirements will be specified in the funding agreements.

What discretion do air districts have in implementing the retrofit program?

The local air districts are given discretion on the selection of projects is conducted. Such flexibility will include focusing on larger fleets where retrofit programs will be more effectively implemented. It is important that the program maximize health benefits to schoolchildren.

While any school district or contractor can qualify for funding to retrofit its buses, the staff encourages air districts to target larger fleets for at least the first year of the program. Focusing on retrofits in larger fleets, or at least fleets where the majority of buses can be retrofitted, is advantageous. It will assure that school districts and school transportation contractors that choose to reduce PM emissions by installing retrofit devices will have adequate support from the retrofit device manufacturers and other technical support. It will also facilitate adequate employee training, reduce opportunities for mis-fueling, and facilitate the availability of low-sulfur fuel.

E. Emission Benefits

The ARB staff estimates that the proposed School Bus PM Retrofit Program will reduce PM emissions by approximately 150 tons from the year 2001 through 2010. This equals about 82 pounds per day. This estimate, based on the ARB's emission inventory EMFAC 2000, assumes that each PM filter has a 10-year/150,000 mile life in school bus applications. To the extent that air districts fund retrofit devices that also achieve NOx reductions, the retrofit program could also achieve NOx benefits.

V. ISSUES

This chapter discusses issues that were the subject of debate during the development of the guidelines.

A. Funding Allocation for New Buses vs. Retrofits

Governor Davis allocated $50 million in ARB's 2000-01 budget; budget control language directed the money to be used for school bus replacements and retrofits. The bus replacement part of the school bus program puts new buses in service, reducing emissions from the school bus fleet and providing safer transportation for school children. The retrofit component of the program equips older buses with PM filters and introduces low-sulfur fuel – both of which are important for the next generation of cleaner diesel technology. Staff initially proposed that $30 million be used for the bus replacement program, and $20 million be used for PM filter retrofits. School transportation officials commented that a greater share of the funding should be dedicated to the bus replacement program. Staff then proposed that $40 million be used for bus replacement and $10 million be used for retrofits. Ultimately, the Board directed that $37.5 million be used for the bus replacement program and $12.5 million be used for the retrofit program. Dollar-for-dollar, particulate traps are the most cost-effective means to reduce children's exposure to cancer-causing exhaust.

B. 3.0 g/bhp-hr vs. 2.5 g/bhp-hr Engines

All heavy-duty diesel engines sold in California must meet a required NOx emissions standard of 4.0 g/bhp-hr. There are a number of alternative fuel engines certified to an optional reduced-emission NOx standard of 2.5 g/bhp-hr. At the time of the approval of the guidelines, no diesel engine was certified below the required 4.0 g/bhp-hr NOx standard.

One manufacturer offers a "green diesel" school bus with an engine that it states will certify to a 3.0 g/bhp-hr NOx standard. This bus is also equipped with a particulate filter, and when operated on low-sulfur diesel fuel, has very low PM emissions. The limited test data available shows that PM emissions from the "green diesel" engine with a particulate filter are as low or lower than PM emissions from a natural gas engine without a particulate filter. The engine manufacturer has advocated funding of the "green diesel" engine under the program.

Whether to include or not to include the intermediate diesel technology in the program guidelines posed a considerable dilemma for staff. On the one hand, the 2.5 g/bhp-hr optional NOx standard has been on the books as a lower-emission goal since 1995. A number of companies have invested millions of dollars to achieve the 2.5 g/bhp-hr NOx goal, and backing off from that level presents an equity issue. In addition, staff believes there is enough demand for alternative fuel buses that if all the funding were dedicated to alternative fuel buses, there would be takers.

On the other hand, this 3.0 g/bhp-hr diesel engine with a particulate filter and low-sulfur diesel fuel is a first step towards introducing the next generation of diesel technology and represents an intermediate level of emissions. (Next steps include engines with exhaust gas recirculation and lower NOx emissions in October 2002. Even lower emission engines are required in 2007.) This intermediate diesel bus costs less than alternative fuel buses. Thus, one could buy more intermediate diesel buses with the limited school bus funding available.

Table 4 below presents a comparative analysis of the emissions of "green diesel" buses with their higher replacement rate, and alternative fuel buses with lower NOx emission levels but lower replacement rate. The analysis shows the emission benefits relative to the baseline if there were be no lower-emission school bus program. The comparative analysis is for $30 million in funding for alternative fuel buses, or for $30 million in funding for intermediate diesel buses. Note that the funding split for the comparative analysis presented here differs from the approved funding split ($25 million for alternative fuel, $12.5 million for intermediate diesel). The estimated emission benefits for the alternative fuel/diesel funding split approved by the Board is presented in Chapter III. The comparative analysis shown here is not intended to estimate the emission benefits of the final funding split, but rather, to show why staff included funding for intermediate diesel buses as part of the original proposal.

TABLE 4

Comparative Emissions Analysis of CNG vs. Intermediate Emissions Diesel Engines ($30M for Diesel or $30M for Alternative Fuel Purchases)

Fuel	Number of Buses	NOx Benefit (tons)	PM Benefit (tons)
CNG	254	706	60
Intermediate diesel	356	878	84

The analysis was calculated based on actual model year distribution of the current school bus fleet. The fleet emissions were projected over the next 15 years, with a modest baseline turnover rate of slightly over four percent, consistent with our EMFAC 2000 inventory. The analysis is based on certification emission levels, not in-use emissions. The analysis also assumes current DGS contract price for the intermediate emissions diesel technology with particulate filter. Note that the analysis is sensitive to a number of parameters including school bus price, fleet turnover rate, and the timing of new standards and requirements for school buses. Thus, this analysis cannot be generalized beyond a school bus application, or beyond this year of the program.

The analysis shows that at comparable funding levels, based on certification emissions, the intermediate diesel option would yield greater PM and NOx emission benefits. Therefore, the Board included funding for intermediate diesel buses as part of the program.

C. Alternative Fuel Buses in the South Coast Region

The South Coast AQMD had expressed interest in implementing the bus replacement program in its area. The South Coast AQMD is discussing an agreement with the CEC. The South Coast AQMD requested the option of increasing the match funding required from the school districts, and it offered to provide some match funding for alternative fuel school buses. The final guidelines do not allow air districts to modify the match funding requirements; however, an air district can choose to use air district funds to pay a portion or all of the match funding requirements.

The South Coast AQMD had also expressed interest in restricting funding to alternative fuel school bus purchases. The Board took no action allowing participating air districts to do other than maintain the funding split statewide of one-third of the monies for diesel buses and two thirds of the monies for alternative fuel buses.

D. Match Funding Requirements

A 25 percent (maximum $25,000) match funding requirement from most school districts was proposed for the purchase of new buses. During guideline development, some school districts opposed a matching fund requirement. However, program funding is limited and requests for funds will far exceed availability. A required funding match will maximize the number of buses that can be purchased and the beneficial air quality impacts of the program. The staff believes that a state funding level of a minimum of 75 percent state is sufficient to induce full school district participation and will allow more lower-emission school buses to be put in use.

The Board did direct ARB staff to provide some relief to those school districts severely impacted by the cost of their transportation services. ARB and CEC staff consulted with representatives of school districts. As a consequence, those school districts with bus fleets comprised of 20 percent or more in-use pre-1977 school buses are now required to provide 15 percent in match money (maximum $15,000) per new bus, provided the new bus replaces a pre-1977 bus. In addition, those fleets must contain at least one pre-1977 bus that travels 10,000 miles or more annually.

Any match funding requirement poses the greatest burden on school districts with a declining enrollment. However, the guidelines provide flexibility by allowing payment of the matching funds upon the delivery of the new bus. Thus, match funds could be made from a 2000-01 or 2001-02 fiscal year budget. School districts are also encouraged to secure match funding from other allowable funding sources, such as local air districts' motor vehicle registration fee programs.

VI. CONCLUSIONS

The Lower-Emission School Bus Program will provide significant emission benefits to schoolchildren, as well as to all residents of California.

What are the goals of the program?

The program sets very ambitious goals. These goals include:

- Replacement of up to 350 high-polluting buses with new lower-emission buses.
- Retrofit of up to 2000 high-polluting buses with exhaust filters.
- Reduction of the criteria pollutants, PM and NOx.
- Reduction of public exposure to toxic diesel particulates.
- New, safer school buses on the road.
- Installation of alternative fuel fueling stations.

Will these goals be met through this program?

Yes, there will be very positive results from this program. First, NOx and PM emissions will be reduced through the operation of the new buses and retrofitted buses. NOx emissions contribute to the formation of ozone. Reductions in NOx will help move areas of the state towards attainment of the national and state ambient air quality standards for ozone and for PM.

Replacement and retrofit of school buses will result in the reduction of children's exposure to localized emissions of toxic diesel particulate matter. In 1998, the ARB identified PM emissions from diesel-fueled engines as a toxic air contaminant. At its September 2000 meeting, the Board adopted the Diesel Risk Reduction Plan for Diesel-Fueled Engines and Vehicles. This plan addresses future controls on diesel PM emissions that will reduce impacts on public health. One of the major components of the plan is to reduce PM emissions from all heavy-duty diesel engines, such as those used in school buses. For more information about the risk reduction plan, please see the ARB's web site at www.arb.ca.gov.

Implementation of this program will also improve public safety. Replacing older school buses means more buses on the road that meet current safety standards, thus providing safer transportation for California's students.

Will technology advancement result?

An additional benefit of this school bus program will be the acceleration of PM retrofit development. Prior to the ARB requirement for retrofit devices that reduce particulate emissions by 85 percent, school districts did not have the opportunity to reduce children's exposure to toxic PM from in-use buses. Also, the ARB's Risk Reduction Plan calls for the retrofitting of all diesel engines by 2010. The retrofitting of school buses is one step in accomplishing that goal.

PM reduction devices require the use of low-sulfur fuel to operate efficiently. By 2006, it is expected that the only diesel fuel available will be low-sulfur fuel. Use of this fuel can reduce both NOx and PM emissions. This program supports low-sulfur diesel fuel use by paying the incremental fuel cost for buses retrofitted under this program.