

STAFF DISCUSSION
Implementing the Moyer Program:
Incentives for Lower-Emission Heavy-Duty Engines

INTRODUCTION

This staff discussion provides some background on the incentive program, and a basic explanation of how the program will work. This discussion also briefly describes the projects eligible for funding, and a proposed methodology for evaluating other types of projects. Staff is requesting your input on the program as described here, and is hoping that this discussion will initiate dialogue at the workshop.

The Air Resources Board (ARB) staff is developing detailed project criteria, as well as emission reduction and cost-effectiveness calculation methodology. Those are being modeled after calculation methodologies used by districts that currently have on-road and off-road incentive programs. ARB staff is also working with interested local air districts and port authorities, who will have primary responsibility for program implementation at the local level, and for approving projects for funding. The first draft of the project criteria and calculation methodology were presented at the first workshop on November 12, 1998. These documents are available on our Web site at <http://www.arb.ca.gov>. A staff report and proposed guidelines will be considered by our Board at a public hearing in February 1999.

This is a high priority program, which due to fiscal deadlines must be implemented quickly. ARB invites your active participation in the development of this program. Working together we can develop and implement an effective program. The success of this one-time, \$25 million program is crucial to our efforts to get funding for a continuing program.

BACKGROUND

Heavy-duty engines are a significant source of smog-forming pollutants. In addition, the fine particulate matter exhaust from heavy-duty diesel engines is a toxic air contaminant. In 1994, ARB worked with industry, environmentalists, government agencies, and experts in the air quality field to put together a long-term plan for bringing clean air to all Californians. That long-term plan is known as our State Implementation Plan, or SIP. Many of the new emission reduction measures in the SIP are heavy-duty engine measures, including standards for new engines, and incentives to reduce emissions from the in-use fleet. Funding was needed for the incentive measures. This May, Governor Wilson proposed \$50 million to fund a heavy-duty diesel engine replacement program. Through the legislative budget process, that proposed funding was reduced to \$25 million.

The incentive program is named after the late Dr. Carl Moyer, in recognition of his work in the air quality field, and his efforts in bringing about this incentive program. The Carl Moyer Memorial Air Quality Standards Attainment Program (the Moyer program) provides grants for the incremental cost of lower-emission heavy-duty engines.

There were two bills before the legislature this year that contained criteria for a heavy-duty engine incentive program. They were Senate Bill 1857 (Brulte) and Assembly Bill 1368 (Villaraigosa). Governor Wilson vetoed both bills in September because of errors in the bills, because they were overly-prescriptive on funding per project category, and because they would have allocated some of the limited program funding to infrastructure. Despite those fatal flaws, many of the criteria in the bills are consistent with the program envisioned by Governor Wilson. ARB staff will be proposing many of those criteria for this program.

GENERAL PROGRAM

1. **What is the purpose of the program?**
The purpose of the program is to reduce emissions from heavy-duty engines by providing grants for the incremental cost of lower-emission engines.
2. **Who will implement the program?**
The ARB is responsible for overall program implementation. ARB will work with the public, local air districts, port authorities, industry, and environmental groups to develop program guidelines. The guidelines will describe what types of projects could be funded, the criteria to evaluate those projects, and how to calculate the emission benefits and cost-effectiveness. Local air districts and port authorities that wish to participate will implement the program locally. This will include program outreach, soliciting project applications, awarding grants, and monitoring projects to ensure the emission reductions are actually achieved.
3. **Who can apply for grants?**
Private companies or public agencies that operate heavy-duty engines in California may apply for grants.
4. **What types of projects are outside the scope of the program?**
The program is not intended to fund engine research and development, certification testing, training, the incremental cost of fuels or fuel additives, or operational controls.

FUNDING

1. **How much funding is available, and what fiscal deadlines apply?**
ARB has a \$25 million dollar appropriation in our budget for the program. Two percent of that funding is allocated to ARB for administrative costs. The remainder will be used to fund projects. ARB must encumber funds by June 30, 1999, through a subvention to an approved district or port authority program, or by committing them through direct project grants. Districts and port authorities must spend the funds by June 30, 2001.
2. **What is the matching fund requirement?**
Districts and port authorities will be required to provide \$1 in district/port funding per every \$2 in state funding for those projects they approve. Districts and ports can use up to 15 percent in-kind contributions (i.e., administrative costs) as matching funds. In addition, districts and ports can use projects funded this fiscal year (beginning July 1, 1998) that would have qualified for the program as part of their matching funds.
3. **What is the cost-effectiveness criterion?**
Projects must have a cost-effectiveness of \$12,000 per ton of NOx reduced, or better. Cost-effectiveness will be based solely on Moyer program funds and motor vehicle registration fee funds.
4. **Can the \$25 million be used to fund infrastructure?**
No, but motor vehicle registration fee (AB 2766 and AB 434) funds can be used for infrastructure. Infrastructure funding to support a qualifying engine project will count as match funding.

GENERAL PROJECT

1. **Which heavy-duty engine categories are eligible for funding?**
 - On-road motor vehicles over 14,000 pounds gross vehicle weight rating.
 - Off-road equipment over 50 horsepower.
 - Marine vessels.
 - Locomotives.

- 2. Will other heavy-duty engine categories be considered?**
Yes. Other heavy-duty engine applications, such as stationary agricultural engines and forklifts, will be considered. Whether or not they are included in the guidelines being developed for consideration in February 1999 will depend on a number of factors. Those factors include the potential for real, quantifiable emission reductions, whether the projects are expected to meet the cost-effectiveness criterion, the immediate availability of the technology, and the likelihood of applicants going forward with that type of project. For this initial \$25 million funding, ARB must balance the need for guidance in multiple project categories with the need to implement the program quickly.
- 3. Will there be an option for funding heavy-duty engine projects that are not included in the guidelines?**
ARB staff would like comments on the need for that option, and the best mechanism to allow flexibility outside the guidelines, but still ensure that public funds are spent on real emission reductions.
- 4. Are the replacement engines likely to be alternative fuel engines?**
That will vary by project category. For some categories, the only technology available that can achieve significant, cost-effective emission reductions is alternative-fuel technology. For other categories, baseline (pre-project) emission levels are very high, and substantial emission reductions can be achieved with new diesel engines. For example, new on-road heavy-duty vehicle projects are likely to be alternative fuel. In contrast, marine vessel engine replacement (e.g., replacing a tugboat engine) is likely to be with a diesel engine.

PROJECT DESCRIPTIONS - INTRODUCTION

On-road vehicle, off-road equipment, marine vessel, and locomotive engine categories are included in this program. For each of those categories, three types of projects are allowed: new engine purchase, repowers, and retrofits. New engine purchase means a new engine in a new vehicle or new piece of equipment. New engine purchases would occur even without this program, as a result of natural fleet turnover. To qualify for incentives, new engine purchases would need to go beyond what is required for new engines. Repowering means putting a new engine in an existing vehicle or piece of equipment, instead of rebuilding the existing engine. Repowering projects would be cost-effective where new engines are substantially cleaner than older in-use engines. Retrofitting means making hardware modifications to the engine to reduce its emissions. Retrofits could involve converting a conventional-fuel engine to an alternative fuel, or adding aftertreatment technology.

PROJECT DESCRIPTIONS - ON-ROAD HEAVY-DUTY VEHICLES

Background

Heavy-duty vehicles include trucks and buses. Currently, heavy-duty vehicles must meet an oxides of nitrogen (NOx) standard of 4.0 grams per brake horsepower-hour (g/bhp-hr). Heavy-duty trucks must meet a particulate matter (PM) standard of 0.1 g/bhp-hr, and urban transit buses must meet a PM standard of 0.05 g/bhp-hr.

Potential Projects

New vehicle purchases of liquefied natural gas (LNG) and compressed natural gas (CNG) trucks and buses are expected to be the most common type of project for the on-road heavy-duty vehicle category. To be eligible under this program, the new vehicle/engine has to be certified to one of ARB's optional NOx emission standards. Table 1 lists the heavy-duty engines that have been certified to the ARB's optional NOx emission credit standards.

For retrofits and repowers, staff is proposing that the engines must be certified to a NOx emissions standard at least 30 percent below the original engine certification standard.

New Heavy-Duty Engines Certified to Optional NOx Emission Standards
(emission levels and standards in grams per brake horsepower-hour)

Manuf.	Service	Fuel Type	Displ (ltr)	NOx	PM	NMHC	Cert. Std. NOx/PM	HP
Cummins	MHD	L/CNG	5.9	1.8	0.02	0.1	2.5/0.10	150/195/230
Cummins	MHD	LPG	5.9	2.3	0.01	0.8*	2.5/0.10	195
Cummins	UB	L/CNG	8.3	2.2	0.02	0.5	2.5/0.05	250/275
Cummins	HHD	L/CNG	8.3	1.8	0.02	0.6	2.5/0.10	250/275
Cummins	UB	L/CNG	10.0	1.4	0.02	0.03	2.0/0.05	280/300
Cummins	HHD	L/CNG	10.0	1.6	0.02	0.1	2.0/0.10	280/300
DDC	UB	CNG	8.5	2.2	0.01	0.6	2.5/0.05	275
PSA**	HHD	Dual	12.0	2.4	0.10	0.5	2.5/0.10	370/410

* Total Hydrocarbons ** Power Systems Associates (using Caterpillar engines)

Dual = Dual Fuel (CNG + Diesel; or LNG + Diesel)

Service Type: MHD (Medium Heavy-Duty), HHD (Heavy Heavy-Duty), UB (Urban Bus)

PROJECT DESCRIPTIONS - OFF-ROAD EQUIPMENT

Background

This category includes off-road industrial equipment over 50 horsepower. This includes farm and construction equipment such as tractors, combines, cranes, and graders. Prior to 1996, these engines were uncontrolled. New engines in this category must meet a NOx emissions standard of 6.9 g/bhp-hr. Effective in 2001, the NOx standard for 175 to 750 horsepower engines will be reduced to 5.8 g/bhp-hr.

Potential Projects

Projects that would qualify for a grant under this program would include new equipment purchase, engine repowers or retrofits. New engine purchases would have to be certified to an optional lower-emission standard for off-road equipment. For repowers, older, uncontrolled off-road equipment could be repowered with a new diesel or alternative fuel engine meeting the 6.9 g/bhp-hr NOx standard. Retrofits could involve converting a conventional-fuel engine to an alternative fuel, or adding aftertreatment technology.

As a criterion for off-road equipment repowering and retrofit projects, staff is proposing that the cleaner engine would need to be certified to an emissions standard that is at least 30 percent lower than uncontrolled baseline NOx emissions. Uncontrolled baseline NOx levels are 13 g/bhp-hr for engines from 50 to 175 hp, and 11 g/bhp-hr for engines over 175 hp.

Staff is also considering capping the grant awards for projects where uncontrolled off-road equipment is repowered with new, certified engines. The caps (see table below) are consistent with some district programs, and were proposed in the legislation.

Maximum Grant Award for Repowering Off-Road Equipment

Horsepower Category	50-199	100-174	175-299	300-499	500+
Maximum Grant (\$/repower)	\$2,000	\$5,000	\$7,000	\$10,000	\$12,000

PROJECT DESCRIPTIONS - MARINE VESSELS

Background

The marine vessel category includes ocean-going vessels and harbor vessels (excluding those used in recreational activities.) All naval and commercial marine vessels like tugboats, crew/supply boats, fishing boats, and large ocean going ships are included in this category.

Engine ratings vary greatly over the marine vessel fleet -- from approximately 500 to 67,000 horsepower. Marine vessels for the most part are propelled by diesel engines, and to a lesser extent by steam turbines or gas turbines. Many of the ocean going vessels are registered in foreign countries, and would not be eligible for grants under this program.

The ARB and the U.S. EPA currently have no emission standards or operational controls for marine vessels. The International Maritime Organization (IMO) has proposed international standards. The new standards would reduce NOx emissions from new diesel engines in ocean going vessels by 30 percent beginning in the year 2000. U.S. EPA is expected to adopt regulations applicable to U.S. flag ships and vessels operating in U.S. harbors once the proposed international standards are adopted.

Potential Projects

Projects that would qualify for a grant under this program would include new engine purchases, repowers, or retrofits. Repowering marine vessels with cleaner diesel engines is expected to result in substantial emission reductions. Retrofitting means making hardware modifications to the engine to reduce its emissions. Retrofits could involve converting a conventional-fuel engine to an alternative fuel, or adding aftertreatment technology. It is anticipated that most of the marine vessel projects funded through this program would be the replacement of tug boat, crew/supply boats, or fishing boat engines with a new diesel engine.

As a criterion for marine vessel projects, staff is proposing that the cleaner engine would need to test at an emissions level that is at least 30 percent lower than uncontrolled baseline NOx emissions level.

PROJECT DESCRIPTIONS - LOCOMOTIVES

Background

There are an estimated 1,200 locomotive engines in California. Of these, about 250 are used as locals, 200 are used in switch yards, 100 are passenger trains, and the remaining 650 are used as line-hauls. The newest engines are typically used in line-haul service. Older line-hauls are retired to short-line fleets, and subsequently to the switchyard. Switchyard trains distribute and rearrange cars within the terminal, and are usually the oldest locomotives. Short-line and switchyard trains are dedicated to in-state service, and most of those engines were manufactured before 1973.

Federal law prohibits California from setting standards for new locomotives and new engines used in locomotives -- only U.S. EPA has that authority. New and in-use locomotives are currently uncontrolled. Uncontrolled NOx emission levels, as reported by U.S. EPA, are 13.0 g/bhp-hr for line-haul and short-line engines, and 17.4 g/bhp-hr for switchyard engines. The U.S. EPA recently adopted emission standards that will go into effect in the year 2000. Those standards (see table below) will apply to new engines, and to 1973 and later engines at the time of remanufacture. In addition to those national new engine standards, there is an agreement that affects the in-use locomotive fleet in the South Coast Nonattainment area. That agreement is a Memorandum of Understanding (MOU) signed by participating railroads, and the ARB in July, 1998. That agreement is for a locomotive fleet average emissions program that will speed the introduction of new, lower-emitting engines in the South Coast Air Basin.

Federal Exhaust Emission Standards for Locomotives				
Effective in Calendar Year 2000, for New Engines and at Remanufacture				
Duty-cycle	Gaseous and Particulate Emissions (g/bhp-hr)			
	HC	CO	NO_x	PM
	Tier 0 (1973 - 2001 model year engines)			
Line-haul duty-cycle	1.00	5.0	9.5	0.60
Switch duty-cycle	2.10	8.0	14.0	0.72
	Tier 1 (2002 - 2004 model year engines)			
Line-haul duty-cycle	0.55	2.2	7.4	0.45
Switch duty-cycle	1.20	2.5	11.0	0.54
	Tier 2 (2005 and later model year engines)			
Line-haul duty- cycle	0.30	1.5	5.5	0.20
Switch duty-cycle	0.60	2.4	8.1	0.24

Source: U.S. EPA, Final Emissions Standards for Locomotives, EPA420-F-97-048, December 1997.

Potential Projects

Projects that would qualify for incentive funding under this program include new engine purchases, repowering, and retrofits. Preliminary cost evaluations indicate that the capital and operating costs of low-NO_x engine controls can be high, depending on the particular technology and individual operation. Each application would need to be carefully evaluated on a case by case basis. As for all categories, the maximum funding available would be based on the \$12,000 per ton cost-effectiveness limit.

Projects submitted for pre-1973 model year (MY) locomotives must show that engine NO_x emissions will be reduced by a minimum of 30 percent below the baseline emission level (generally, the uncontrolled emission rate). Projects submitted for 1973 and later MY locomotives must consist of engines that are certified to the federal Tier 1 or Tier 2 locomotive NO_x standards.