

August 20, 2000

Diesel Engine Emission Reduction Workshop

(August 20-24, 2000)

WHEN CAN WE DROP THE “DIRTY” FROM DIESEL?

William J. Keese, Chairman, California Energy Commission

Our affluent society consumes more and more goods. These goods and the materials used in producing them are transported several times by so-called “dirty” diesel trucks before getting to the consumer. Later, they may make their final journey to the landfill or recycling center in another “dirty” diesel truck.

I am here tonight to suggest that we should strengthen our support for advancing the state of diesel engine technology. Our goal is striking a balance between efficiency and low emissions but not accepting less than the best of both. The technologies being presented here at this workshop will play a critical role in avoiding any need to trade off one benefit for the other.

Diesel engines are the overwhelming choice when there is work to be done. They are the most efficient, durable, and reliable way to move freight and heavy goods. Today, diesel engines offer energy efficiencies of nearly 50% in actual on-road truck

operation. Even the best simple-cycle steam turbines used for electric power generation or large ships cannot match this level of efficiency.

Large steam turbine engines used to be the most efficient way to turn fossil fuel energy into power. In recent years, the large slow-speed diesel engine has become the most efficient engine-of-choice for new large ships (other than Navy capital ships). Efficient diesel engines may even become a desirable way to generate distributed electric power close to consumers to improve system reliability.

Class 8 diesel engine trucks loaded to the 80,000 lb. highway limit routinely achieve over 7 mpg while many gasoline-engine light-duty trucks that weigh less than a tenth of that can barely get 14 mpg. Diesel engines *can* nearly double the fuel economy for the increasingly popular large pickup trucks, vans, and SUVs that are contributing disproportionately to the nation's growing consumption of gasoline. However, they face difficulties in meeting the advanced light-duty vehicle emission targets that California is pursuing for the future.

I am impressed with the performance of the pickup trucks with prototype diesel engines showcased here today for *both* their high efficiency and low emissions without sacrificing good performance. With continued federal and state support, we believe that more efficient diesel-powered, light-duty trucks and SUVs can compete for a share of the California market. I expect that discussions during this workshop will address some of the market barriers to achieving the benefits of low emissions, efficiency, power, and driveability.

The California Energy Commission is charged with ensuring that energy resources are used consistent with our society's needs for public health and the quality of life. We must reemphasize the need to balance energy efficiency, energy diversity and clean transportation energy goals.

The Energy Commission has supported alternative fuel vehicles to gain both fuel diversification and air quality benefits. We have taken advantage of the leverage that tough air quality regulations provide to also achieve fuel diversification benefits.

Today, the automobile industry and the oil industry have responded with advanced emission controls for gasoline engines and with cleaner gasoline formulations. Gasoline engines have advanced to the point of 99% emission control, which diminishes the benefits from cleaner alternative fuels.

Now that gasoline technology has responded to the challenge of cleaner, alternative fuels, it's time for to sharpen our focus on diesel. We challenge the industry to approach gasoline emission control levels with improved diesel engines, advanced aftertreatment technology and cleaner fuels.

Still another challenge is producing diesel engine technologies that can use a range of fuels from diverse sources. Our goal is to achieve the highest efficiency with the lowest emissions of ozone precursors, toxic particulates, and greenhouse gases. Progress with diesel engine emission control technology is already being made to achieve the extremely low levels proposed by EPA for 2007. Our hope is that we can achieve

these standards while maintaining the fuel efficiency benefit that diesel engines offer.

Diesel engines in heavy trucks, buses, construction equipment, farm tractors, diesel marine vehicles, and locomotives have become the largest source of NO_x emissions in both current and projected statewide emission inventories. This trend reflects the growing demand for transportation services that diesel engines provide. But, to a large extent, this also results from the industry's success in pushing gasoline car emissions to near-zero levels.

When gasoline emission control technology was progressing rapidly, there was less emphasis placed on diesel controls. This lag means that the diesel portion of the emission inventory has grown to become a large and fruitful remaining source for future emission reductions. So it is not surprising that diesel engines have become the target of future air quality regulations, since they are the largest source of future NO_x emission reductions needed to attain federal and state ozone standards.

Air basins in California face the threat of losing billions of dollars in federal funds for transportation projects if California does not show progress towards attainment of health-based federal ozone standards.

Last year, Governor Davis signed legislation codifying the Carl Moyer Memorial Air Quality Standards Attainment Program. The Energy Commission helped launch this program that is leading the nation in funding cost-effective NO_x reductions from both alternative fuels and cleaner diesels.

The Legislature is currently considering additional funding for the Sacramento and the San Joaquin Valleys to reduce NO_x to meet these areas' near-term attainment deadlines.

The founders of the Carl Moyer Program identified existing shortfalls in attaining federal ozone standards as providing leverage to get clean natural gas trucks into the marketplace. The Energy Commission has found that cleaner diesel engines could also provide NO_x reduction benefits. Through the purchase of new, low-NO_x natural gas engines and the

replacement of older and less efficient “dirty” diesels, the Carl Moyer program is generating NO_x reduction benefits at a cost ranging from \$3,000 to \$12,000 per ton of NO_x reduced. This cost range is dramatically lower than other alternatives.

To meet the EPA’s proposed 2007 standards for heavy-duty engines, diesel engine emissions will need to be equivalent to light-duty gasoline low-emission vehicles. Technology suppliers are offering a cornucopia of control devices that will make extremely low emission levels possible, but this will require new investments in advanced technology.

The Energy Commission has invested \$2 million of last year’s allotment of the Carl Moyer Program’s Technology Advancement funds for three important diesel aftertreatment technology projects:

- Englehart’s catalyzed soot filters, using ARCO’s ultra-low sulfur fuel, will allow high exhaust gas recirculation for low NO_x;

- Ceryx's development of a "QuadCAT" combines a catalyzed soot filter with catalytic HC, CO, and NO_x reduction in one exhaust system package; and
- Delphi Automotive Systems' development of a non-thermal plasma system that promotes NO_x reduction on a catalyst.

The Energy Commission plans to offer an additional \$2.2 million later this year to support diesel emission control technology development.

Oil refiners will also face major investment decisions for refinery processes to reduce sulfur and modify other fuel properties to support a new generation of diesel engines.

Collectively, we need to carefully monitor the development of diesel emission control technologies and how they perform with actual sulfur levels. As we have experienced with automobiles, we expect these engine and fuel formulation changes to occur without loss of the fuel efficiency, reliability, and durability that have made diesel the clear choice of heavy vehicle operators worldwide.

You may be wondering why the state's energy agency is concerned about air quality regulation? Air quality regulations have achieved dramatic progress despite the strong growth in demand for vehicles and fuel. Although gasoline engine technology, particularly computer feedback-controlled fuel injection, has allowed fuel economy to improve along with reducing emissions, the growth in demand for gasoline and less-efficient gasoline-powered light-duty trucks threatens to overwhelm the supply.

The potential for efficient and clean diesel engines to replace less efficient gasoline engines in the large pickup truck, van, and SUV market sector currently appears to be challenged by the need to meet future emission standards. Broader thinking will be needed to incorporate energy efficiency into vehicle emission standards. Consideration of greenhouse gas emissions may be one way to do this.

Diesel engine manufacturers and fuel producers must address the concerns expressed by the scientific community about the

public health effects of emissions from current and future diesel and alternative fuel engines. Better scientific evidence is needed to help guide us on a path to improved levels of energy efficiency and emission performance levels. Further studies are needed that focus on the composition and size of diesel exhaust particulates, how these properties affect human health response, and how they change with the application of new emission controls.

Studies are sorely needed to quantify the health-related gains from the years of investment in cleaner diesel engine and fuel formulation technologies. Let us recognize the progress that has already been made in cleaning up diesel engines and encourage further progress for future product offerings.

At the Federal level, we were disappointed to hear of the proposed cuts in the Program for a New Generation Vehicle (PNGV). This Program has chosen diesel engines with hybrid electric technology to achieve the goal of tripling fuel economy with low emissions. I wonder if the proposed cuts reflect a lack of acceptance of the diesel engine (called CIDI in the program for Compression Ignition Direct Injection). This technology,

however, was ultimately selected because of its superior ability to satisfy the tough PNGV program goals.

It is inevitable that one day, inexpensive sources of petroleum will be exhausted. Forecasters may disagree on the specific timing, but we can certainly expect our children to feel the effects of declining reserves within their lifetimes. The use of efficient diesel engines can certainly extend the life of this resource. There is no reason for complacency or a willingness to make this day come sooner than needed, since *there are alternatives*.

Diesel engines *can* use fuels other than petroleum diesel.

Diesel engines can use *synthetic* diesel fuels produced from natural gas, oil shale, tar-sands, biomass, methane hydrates, and coal. These abundant fuel resources will last long after inexpensive petroleum reserves have been exhausted. We can already see optimistic results from a gas-to-liquid process called “Fischer-Tropsch” that produces a superior high-cetane and zero-sulfur fuel from natural gas. This synthetic diesel fuel

burns directly in unmodified diesel engines and can be mixed into petroleum diesel stocks in any ratio to upgrade product streams.

Low-priced stranded gas resources can be monetized with newly available synthetic fuel production processes to compete with high-priced petroleum. Enterprising companies are now actively pursuing this alternative. GTL may turn out to be a pathway that allows us to deal gracefully with declining petroleum reserves (and increasing petroleum prices) without the major disruptions that might otherwise be expected.

Additionally, diesel engines can be modified to use natural gas directly while still providing diesel power and efficiency.

Today, Caterpillar has produced dual-fuel, natural gas/diesel engines that use pilot injection of diesel fuel to ignite LNG or CNG. These engines are hauling groceries to supermarkets in California and Texas. CAT Dual-Fuel engines also power commuter buses in Santa Barbara, trash trucks in San Diego, and cattle and feed haulers in Coalinga.

In the near future, Cummins/Westport HPDI engines, which feature high-pressure direct-injection of both LNG and diesel fuel, will also haul groceries and other goods. Both of these engine technologies can be applied to existing diesel engines to cut emissions in half and *both retain* the horsepower, torque, fuel efficiency, reliability, and durability that diesel engine customers demand.

We see value in these technologies to use natural gas in diesel engines as good examples of balancing air quality and fuel diversification benefits. They provide air quality benefits now while maintaining the diesel performance and fuel efficiency attributes required by the customer.

The Energy Commission has joined with the South Coast Air Quality Management District and DOE's National Renewable Energy Laboratory in cofunding two projects to develop ultra-low NOx emission natural gas engines. These projects with Detroit Diesel and Cummins/Westport are aimed at an 80% reduction from current low-NOx levels, for production prior to 2004.

As I have mentioned, a variety of heavy-duty natural gas engines are breaking into the market in California with incentives from the Carl Moyer Program based on their lower NO_x emissions. The Energy Commission also is sponsoring small-scale, local LNG production projects that offer lower LNG prices from low-priced landfill and other gas supplies that are located close to the demand.

A fine example of a Carl Moyer Program success is the LNG truck operation at Harris Ranch in Coalinga, California. Harris Ranch is a large agribusiness in the southern San Joaquin Valley that is currently operating 12 Class 8 LNG/diesel dual-fuel trucks. The Energy Commission approved the use of Department of Energy and Petroleum Violation Escrow Account grant funds to construct an LNG fueling facility at the Harris Ranch feed lot on Interstate highway 5 that is the first element of the Interstate Clean Transportation Corridor (ICTC).

Each of these trucks provides approximately one ton per year of NO_x reductions (as well as displacing about 10,000 gallons of

diesel per year) in exchange for a one-time investment of approximately \$35,000 for the additional purchase price. In addition to the NO_x reduction benefits to the public, Harris is reporting up to 5¢/mile savings for LNG versus higher-priced diesel fuel.

Another example is the LNG/diesel dual fuel truck fleet at The Vons Companies in Santa Fe Springs, California. The Energy Commission approved funds for construction of the second LNG fueling facility along the Interstate Clean Transportation Corridor for Vons' current fleet, composed of 30 Class 8 LNG/diesel dual fuel grocery delivery trucks. This fleet, which is planned to grow to up to 60 trucks in the near future, is also generating major NO_x reduction and fuel diversification benefits.

Just as California took the lead in cleaning up the gasoline automobile, we are now making progress in cleaning up the diesel truck. We have not had to sacrifice the personal mobility we get from gasoline cars, and we will not sacrifice the access to goods we get from diesel trucks. Just as advanced technology in

modern gasoline engines provides improved performance and fuel economy along with dramatically reduced emissions, we expect that advanced technology in future diesel engines will provide similar benefits for the fleet owners that will buy them and the public that will live with them.

I am confident that with tremendous progress with technology, highly efficient and low-emission diesel engines will be possible. I look forward to the day we can drop the “dirty” from diesel.