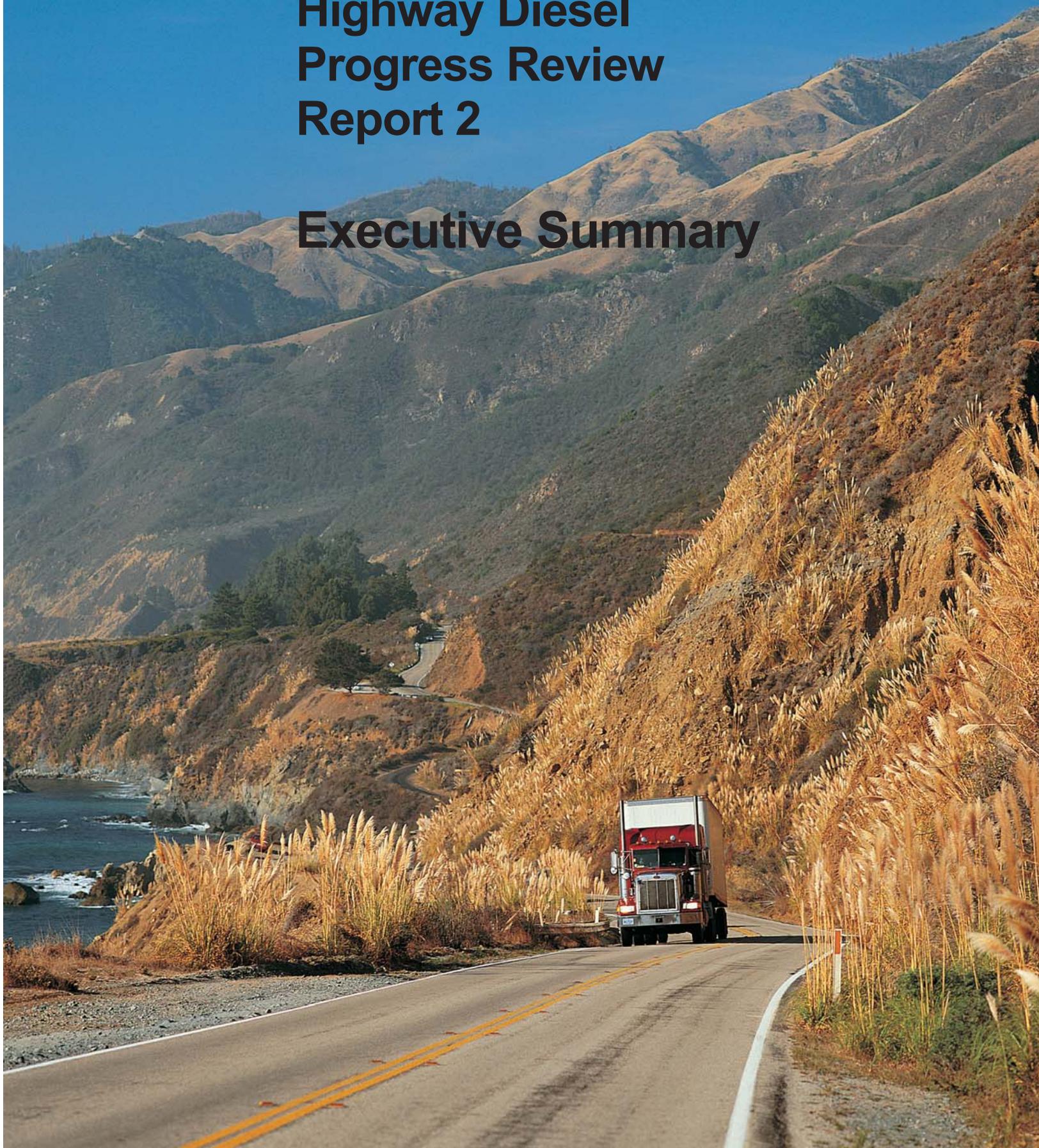


Highway Diesel Progress Review Report 2

Executive Summary



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Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

NOTICE

*This Technical Report does not necessarily represent final EPA decisions or positions.
It is intended to present technical analysis of issues using data that are currently available.*

*The purpose in the release of such reports is to facilitate an exchange of
technical information and to inform the public of technical developments.*

Executive Summary

The Environmental Protection Agency (EPA or the Agency) established in 2000 new far reaching emission standards beginning in 2007 for heavy-duty diesel vehicles and the fuel used in them. These standards were premised on the introduction of new catalyst based emission controls for diesel engines and the removal of a catalyst poison, sulfur, from diesel fuel. The scale of the changes and the long-term benefit for society have only one parallel in the thirty plus year history of mobile source emission control: the introduction of unleaded gasoline and catalysts on cars in the 1970s. The monetized benefits of this program exceed its cost by more than 16 to one.

Given the scope of these new regulations and their importance for public health, it is only prudent that the Agency carefully follow the progress of industry in implementing this rule. This report is the second in a series of technical progress reviews by EPA to document the status of engine and vehicle technology development to meet the 2007 standards. The first report, published in June of 2002, concluded that progress to that time had been substantial and was in keeping with the expected progress necessary for successful implementation of the new standards in 2007. We concluded this based primarily on the extensive research efforts since the rule was finalized and the good results from that research.

This second report also considers the continuing progress in the research laboratory but, more importantly, the transition of these technologies from research into business plans, product development programs, engines and vehicles for field testing, and finally into real products for sale in the marketplace in 2007. Thus, while we continue to be impressed by the amount of technical progress shown in the laboratory, it is the concrete steps that manufacturers have taken in their new product development programs that gives us great confidence for 2007.

The data that we have used in reaching the conclusions summarized here come from a number of sources gathered over the last year and a half. The most compelling evidence, and that which we rely on most heavily, came from confidential one-on-one technical and business reviews conducted with engine manufacturers and with manufacturers of emission control technologies. EPA has met with almost 30 companies to gather this information and to understand fully the breadth of development for 2007. The companies we have met with are making substantial investments to bring products to the market for 2007 because of the confidence they have in those products.

As projected by the Agency in the 2007 rulemaking, all manufacturers are planning to use catalyzed diesel particulate filters (CDPFs) to comply with the 2007 particulate matter (PM) standard. In applications where 15 ppm sulfur diesel fuel is available, manufacturers have already introduced PM filter systems on engines for urban and school buses meeting the 2007

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standards. This report documents the continued improvements in CDPF system technology to improve filter regeneration, lower fuel consumption, and reduce maintenance.

The report documents substantial progress to develop the NO_x adsorber technology including improvements in catalyst formulation, durability, overall system performance and vehicle integration. In fact, late last year the first light heavy-duty diesel truck equipped with the NO_x adsorber technology went into limited production in Japan. Although, we are not projecting that NO_x adsorbers will be broadly used in 2007 to comply with these standards, we are continuing to conclude from the evidence shared during our review that manufacturers could comply using the NO_x adsorber technology in 2007.

For 2007, all of the engine manufacturers have demonstrated the ability to further improve their current 2004 NO_x emission control systems (either cooled EGR or ACERT™) to comply with the program. While the final NO_x standard in 2010 is 0.20 g/bhp-hr, the 2007 program includes a number of implementation flexibilities that will allow manufacturers to comply with engines meeting an averaging level of approximately 1.2 g/bhp-hr in the years 2007-2009. All engine manufacturers have indicated they intend to adopt such a two-step compliance strategy. This strategy will allow engine manufacturers that choose to do so to make incremental changes to their current proven 2004 products for NO_x control in 2007.

Engine manufacturers that sell similar products in Europe will have urea SCR based solutions for Euro IV that could be adopted to the US standards provided they can address issues related to urea infrastructure and end-user compliance. Two engine manufacturers are considering such an approach for 2007 in a limited way for centrally-fueled fleets. While it seems unlikely that such an approach could be broadly applied by 2007 given the significant urea infrastructure that would need to be put in place we believe such a solution could have a limited role in 2007 and potentially a broader role by 2010.

All of the engine manufacturers follow similar new product introduction programs built around a series of milestone reviews (i.e., gateway reviews to the next step in product development). The first of these gateway reviews defines the step from research to product development and requires that manufacturers have defined the product they intend to build, a target production cost, a business plan built around that target cost, and the resources necessary to bring the product to market. Prior to this step, engine manufacturers and technology suppliers have worked primarily to prove out potential technology solutions from which an engine manufacturer can then choose to define a new product. Completing this step means manufacturers are ready to begin the hard but well-defined work of successfully bringing a new product to market.

In earlier meetings with engine manufacturers, they indicated to us their confidence that they would be able to clear this first crucial step for 2007 products successfully and on time.

The manufacturers have been working over the last year to complete all of the necessary analyses required to complete this first milestone review. The detailed confidential information shared with the Agency during our meetings reflected these analyses. In the time between our last detailed review meetings and the drafting of this report, four of the five major engine manufacturers have completed this crucial first step. The one company that has not completed this step has indicated to the Agency that it will in the coming weeks. The fact that the engine manufacturers have cleared this gateway says clearly that companies are on track to comply with the 2007 standards. This is not to say that no development tasks remain or that the remaining challenges are trivial. Substantial work to prove out these engines must be done over the next three years prior to their introduction in 2007, but completing this review step means manufacturers have concluded that the issues they have identified will be satisfactorily addressed in the hard work of their development programs.

To help allay concerns expressed by some in the trucking industry, engine manufacturers are planning to use their normal product development process as an avenue for their customers to learn more about the 2007 products. The manufacturers are indicating they will provide early prototype vehicles for selected customer testing in 2005.

This second progress report documents an extensive range of ongoing emission control technology development. Whether for PM or NO_x control, the ingenuity shown by industry to develop better technologies or further enhance existing emission control solutions for diesel engines is impressive. Yet, it is not this impressive progress that provides us with continued confidence that 2007 products will be developed on time, but rather the fact that manufacturers can say with confidence that they have technological solutions that can be brought to market through their rigorous product development programs. Based on our careful review of both the detailed confidential information shared with the Agency during this review and the broader public information summarized in this report, we can conclude:

- Engine manufacturers are on track for 2007 implementation.
- CDPFs will be used by all manufacturers for PM control.
- Generally, manufacturers will treat the NO_x standards as a two-step process.
- All manufacturers can comply in 2007 with existing proven technologies.
- NO_x control should not adversely affect fuel consumption and improvement may be possible over today's engines.
- Engine manufacturers will provide prototype vehicles in 2005 for early customer fleet testing consistent with their product development plans.
- Engine manufacturers' 2007 compliance plans are a building block for the technology package they plan to use to meet the 0.20 g/bhp-hr NO_x standard in 2010.