

potential for high fuel consumption. Our review of progress has left us more certain than ever that practical system solutions can be applied to control emissions using NO_x adsorbers. We have tested a diesel passenger car (one of the most difficult packaging situations) with a complete NO_x adsorber and particulate filter system that demonstrated both exceptional emission control and very low fuel consumption.¹⁵⁹ Heavy-duty engine manufacturers have shared with us their improvements in system design and means to regenerate NO_x while minimizing fuel consumption.¹⁶⁰ Our own in-house testing program at the National Vehicle and Fuel Emissions Laboratory (NVFEL) is developing a number of novel ideas to reduce the total system package size while maintaining high levels of emission control and low fuel consumption rates as discussed more fully in the draft RIA. Similarly, a number of Department of Energy (DOE), Advanced Petroleum Based Fuel—Diesel Emission Control (APBF-DEC) program NO_x adsorber projects are working to address the system integration challenges for a diesel passenger car, a large sport utility vehicle and for a heavy heavy-duty truck.¹⁶¹ By citing these numerous examples, we are not intending to imply that the challenge of integrating and packaging advanced emission control technologies is easy. Rather, we believe these examples show that even though significant challenges exist, they can be overcome through careful design and integration efforts. Nonroad equipment manufacturers have addressed similar challenges in the past when they have added additional customer features (e.g., packaged an air-conditioning system) or in accommodating other emission control technologies (e.g., charge air cooling systems).

All of the issues described above and highlighted first during the HD2007 rulemaking are likely to be concerns to nonroad engine and nonroad equipment manufacturers. We believe the challenge to overcome these issues will be significant for nonroad engines and

equipment. Yet, we have documented substantial progress by industry in the last year to overcome these challenges, and we continue to believe based on the progress we have observed that the NO_x adsorber catalyst technology will be mature enough for application to many diesel engines by 2007. In the case of NO_x adsorber temperature window, which could be especially challenging for nonroad engines, we have performed an analysis summarized below in section III.E.2 and documented in the draft RIA, that leads us to conclude the technology can be successfully applied to nonroad engines provided there is some additional lead time for further engine and catalyst system technology development. Similarly, we acknowledge that the diverse nature and sheer number of different nonroad equipment types makes the challenge of packaging advanced emission control technologies more difficult. Therefore, we have included a number of equipment manufacturer flexibilities in the program proposed today in order to allow equipment manufacturers to manage the engineering resource challenges imposed by these regulations.

Another NO_x catalyst based emission control technology is selective catalytic reduction (SCR). SCR catalysts require a reductant, ammonia, to reduce NO_x emissions. Because of the significant safety concerns with handling and storing ammonia, most SCR systems make ammonia within the catalyst system from urea. Such systems are commonly called urea SCR systems. (Throughout this document the term SCR and urea SCR may be used interchangeably and should be considered as referring to the same urea based catalyst system.) With the appropriate control system to meter urea in proportion to engine-out NO_x emissions, urea SCR catalysts can reduce NO_x emissions by over 90 percent for a significant fraction of the diesel engine operating range.¹⁶² Although EPA has not done an extensive analysis to evaluate its effectiveness, we believe it may be possible to reduce NO_x emissions with a urea SCR catalyst to levels consistent with compliance with the proposed NO_x standards.

However, we have significant concerns regarding a technology that requires extensive user intervention in order to function properly and the lack of the urea delivery infrastructure

necessary to support this technology. Urea SCR systems consume urea in proportion to the engine-out NO_x rate. The urea consumption rate can be on the order of five percent of the engine fuel consumption rate. Therefore, unless the urea tank is prohibitively large, the urea must be replenished frequently. Most urea systems are designed to be replenished every time fuel is added or at most every few times that fuel is added. Today, there is not a system in place to deliver or dispense automotive grade urea to diesel fueling stations. One study conducted for the National Renewable Energy Laboratory (NREL), estimated that if urea were to be distributed to every diesel fuel station in the United States, the cost would be more than \$30 per gallon.¹⁶³

We are not aware of a proven mechanism that ensures that the user will replenish the urea supply as necessary to maintain emissions performance. Further, we believe given the additional cost for urea, that there will be significant disincentives for the end-user to appropriately replenish the urea because the cost of urea could be avoided without equipment performance loss. *See NRDC v. EPA*, 655 F. 2d 318, 332 (D.C. Cir. 1981) (referring to “behavioral barriers to periodic restoration of a filter by a [vehicle] owner” as a valid basis for EPA considering a technology unavailable). Due to the lack of an infrastructure to deliver the needed urea, and the lack of a track record of successful ways to ensure urea use, we have concluded that the urea SCR technology is not likely to be available for general use in the time frame of the proposed standards. Therefore, we have not based the feasibility or cost analysis of this emission control program on the use or availability of the urea SCR technology. However, we would not preclude its use for compliance with the emission standards provided that a manufacturer could demonstrate satisfactorily to the Agency that urea would be used under all conditions. We believe that only a few unique applications will be able to be controlled in a manner such that urea use can be assured, and therefore believe it is inappropriate to base a national emission control program on a technology which can serve effectively only in a few niche applications.

This section has described a number of technologies that can reduce

¹⁵⁹ McDonald, J and Bunker, B. “Testing of the Toyota Avenis DPNR at U.S. EPA—NVFEL,” SAE 2002-01-2877.

¹⁶⁰ Hakim, N. “NO_x Adsorbers for Heavy Duty Truck Engines—Testing and Simulation,” presentation at Motor Fuels: Effects on Energy Efficiency and Emissions in the Transportation Sector Joint Meeting of Research Program Sponsored by the USA Dept. of Energy, Clean Air for Europe and Japan Clean Air, October 9–10, 2002. Copy available in EPA Air Docket A–2001–28.

¹⁶¹ Details with quarterly updates on the APBF-DEC programs can be found on the DOE website at the following location <http://www.ott.doe.gov/apbf.shtml>.

¹⁶² “Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels”, Manufacturers of Emissions Controls Association, June 1999 Air Docket A–2001–28.

¹⁶³ Fable, S. et al, “Subcontractor Report—Selective Catalytic Reduction Infrastructure Study,” AD Little under contract to National Renewable Energy Laboratory, July 2002, NREL/SR–5040–32689. Copy available in EPA Air Docket A–2001–28.