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# Meeting the Diesel Challenge
# Retrofitting Engines

There are more than 20 million diesel engines currently in use nationwide, including some 13 million in highway vehicles, 7 million nonroad equipment, and 47,000 locomotives and marine vessels. Clearly, the U.S. economy is, in large part, powered by diesel engines.

While diesel engines are driving the economy, however, they are also emitting tons of harmful air pollutants. Diesel engines are a significant source of nitrogen oxides ($NO_x$) and particulate matter (PM). The U.S. Environmental Protection Agency (EPA) has identified diesel exhaust as a likely carcinogen. Pollution from diesel engines contribute to thousands of premature deaths, hundreds of thousands of asthma attacks, millions of days of lost work, and numerous health impacts each year. Reducing emissions from diesel engines is one of the most important public health challenges facing the United States.

Fortunately, there are a variety of cost-effective technologies that can dramatically reduce diesel engine emissions. EPA's Office of Research and Development (ORD) is actively working with stakeholders and partners to advance technologies for retrofitting diesel engines currently in use.

## Environmental Technology Verification Program

In 1995, ORD established the Environmental Technology Verification (ETV) program to foster the development of innovative or improved technologies that could benefit human health and the environment. The goal of the program is to verify the performance of commercial-ready environmental products so that they can quickly reach the marketplace, where they can provide both environmental and economic benefits.

The program operates as a public–private partnership between EPA and four nonprofit research institutes, and comprises six ETV Technology Centers: air pollution control, advanced monitoring systems, drinking water systems, greenhouse gases, water quality protection, and materials management and remediation.

ETV's Air Pollution Control Technology (APCT) Center, operated in cooperation with RTI International, verifies commercial-ready technologies that control stationary and mobile air pollution sources—including retrofit technologies for diesel engines. ETV engineers and scientists work with commercial vendors to generate quality-assured, independent, third-party data.

The APCT Center employs testing protocols in three technological areas: retrofit devices (i.e., exhaust treatments generally for PM and volatile organic compounds); retrofit selective catalytic reduction devices for $NO_x$ control; and alternative liquid fuels, fuel additives, fuel emulsions, and lubricants.

*For more information on the research discussed in this column, contact Deborah Janes, Public Information Officer, U.S. Environmental Protection Agency (B205-01), Office of Research and Development, Research Triangle Park, NC 27711; phone: 1-919-541-4577; e-mail: janes.deborah@epa.gov.*



**Resources**

***ORD's ETV program:***

EPA's Environmental Technology Verification System (ETV): www.epa.gov/nrmrl/std/etv/index.html

ETV Air Pollution Control Technology Center: www.epa.gov/nrmrl/std/etv/center-apc.html

Research Highlights: ETV Verifies Diesel Emission Controls: www.epa.gov/nrmrl/news/news112008.html

***Office of Transportation and Air Quality diesel programs:***

National Clean Diesel Campaign: www.epa.gov/diesel/

Publications: www.epa.gov/otaq/diesel/publications.htm#deraprogress

## Case Studies of Diesel Retrofit Technologies

In 2006, EPA published *Environmental Technology Verification (ETV) Program Case Studies*,[1] a report highlighting some of the environmental and health benefits of products that have gone through the ETV program. The report quantified the benefits of seven technologies used to retrofit existing heavy-duty diesel trucks, buses, and nonroad equipment.

The report quantified the environmental benefits derived from using retrofit technologies on 1,345 vehicles, based on an analysis of sales and marketing data that identified existing in-use, or soon-to-be installed, ETV-verified products. The benefits include a reduction in PM emissions of 6.4–9.1 tons over seven years, with associated hydrocarbon (HC) and carbon monoxide (CO) reductions of up to 35 tons, respectively, over the same time period. The PM reduction calculates to a potential economic benefit of US$3.3–4.5 million, attributed largely to preventing adverse health effects and premature deaths.

With millions of heavy-duty diesel trucks, buses, and nonroad equipment currently in use, there is potential to significantly increase emission reductions. For the 2006 report, ETV engineers and researchers estimated that if only 10% of the current fleet of heavy-duty diesel buses and trucks that could incorporate ETV-verified diesel retrofit technology actually did, the potential benefits would include:

- PM emissions reduced by approximately 9,000 to 31,000 tons over seven years, with associated HC and CO reductions of up to 148,000 tons and 393,000 tons, respectively; and
- US$4.4–15.5 billion (in 1995 dollars) in economic benefits realized by way of the health and environmental benefits associated with the above PM reductions

## Supporting Partners and Stakeholders

The 2006 report and its study of the benefits of ETV's diesel retrofit program illustrate the potential that retrofit technologies offer both in reducing pollution and protecting human health.

The ETV program continues to offer important technical support and data sources to EPA's regulatory and volunteer efforts to reduce diesel emissions, such as the Diesel Emissions Reduction Program (a provision of the Energy Policy Act of 2005) and the associated National Clean Diesel Campaign (NCDC), both managed by EPA's Office of Air and Radiation.

The NCDC uses vendor-supplied ETV data and tested technologies as one of its sources for identifying cost-effective, viable retrofit technologies for diesel emission reductions. This information is shared with stakeholders and partners, such as fleet owners, engine manufacturers, emission technology vendors, and state and local governments.

Financial support for installing improved retrofit control devices is available through EPA grant programs, most recently appropriated by Congress for the Diesel Emission Reduction Program under the Energy Policy Act of 2005 and the American Recovery and Reinvestment Act of 2009.

Because the existing fleet of millions of diesel engines could remain in operation for another 25–30 years, retrofit technologies are expected to play a critical role in helping EPA and state and local governments meet their air quality goals. EPA will continue its research efforts to help pave the way for these new technologies. **em**

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### Reference

1 *ETV Program Case Studies: Demonstrating Program Outcomes*; U.S. Environmental Protection Agency, 2006; available at www.epa.gov/nrmrl/std/etv/pubs/600r06001.pdf.