

After Diesel: Technologies for Cleaner Cars, Trucks, and Trains

The diesel engine has been the powerplant of choice for commercial applications. It still remains the powerplant of choice for many geographical locations around the globe such as Europe and Asia. In the United States, while heavy-duty applications such as the Class VIII trucks, trains, and marine have predominantly used diesel engines, passenger car and light-truck applications have lagged behind. The main reasons for the popularity of the diesel engines are related to their frugal use of fuel and their durability. Today, several countries having signed the Kyoto agreement are struggling to meet the new limits imposed on CO₂ emissions. Diesel engines are considered by these countries as part of the solution due to their low CO₂ contribution to environmental inventories.

In spite of its good attributes, the diesel engine has been singled out by the environmentally-conscious groups because of its adverse contribution to the ozone and particulate matter. The technical community has been very active in developing solutions for diesel's ozone and particulate problems. These solutions have proven their capability in allowing the diesel engine in meeting very stringent emissions limits. However, the projected installation and operating cost of these solutions is rather high and in many cases exceeds some of the economical advantages of diesel engines. Therefore, technical developments in the engine and transportation industry have been investigating alternatives.

Alternatives considered by the transportation industry involve some traditional as well as novel technologies for various applications. Of the traditional technologies the hybrid has made its mark on the light-duty market in the USA. Some have considered another traditional approach of alternative fuels such as CNG, LPG, and hydrogen. Each of these fuels has its advantages and disadvantages. While we must continue to entertain all of these possibilities a more pragmatic approach has been adopted by Southwest Research Institute.

At Southwest Research Institute researchers have been involved in advanced diesel and gasoline engines development for sometime. They have become aware of the increased cost burden due to emission controls for diesels. Meanwhile, they have participated in advanced combustion technologies aimed at improving the fuel economy of gasoline engines. These engines have already achieved extremely low emissions using advanced 3-way catalyst technology. With the new combustion concept referred to as High Efficiency Dilute Gasoline Engines or HEDGE for short, not only will emissions be kept extremely low, but improvements in efficiency will approach that of the diesel engine. This is a pragmatic and practical approach since it maintains the low emissions profile of a gasoline engine as well as achieves the efficiency of a diesel while maintaining the fuel infrastructure. It is considered an excellent alternative that uses mostly modified traditional technologies with a few novel ideas to obtain a major leap in engine efficiency and maintain clean environment.

This presentation is in two parts. The first part outlines what is needed for diesel engines to comply with the 2010 EPA emissions limits and the cost projection for this technology. The second part introduces the HEDGE concept and its promise.