



Natural Gas School Buses

Driving Our Kids to a Cleaner Tomorrow

ENERGY
EFFICIENCY AND
RENEWABLE
ENERGY

OFFICE OF
TRANSPORTATION
TECHNOLOGIES



Transportation FOR THE 21ST CENTURY

Background

School districts across America are searching for ways to meet increasingly stringent emissions regulations for heavy vehicles, including school buses, while maintaining performance, functionality, safety, and cost competitiveness. One alternative is a heavy-duty engine fueled by natural gas. Natural gas vehicles (NGVs) produce lower levels of most pollutants than gasoline or diesel powered vehicles. The successful incorporation of natural gas engines into school buses today is largely attributed to the U.S. Department of Energy's Office of Transportation Technology's (OTT) cost-shared partnership with industry through a vision known as the "Bus of the Future."

The Technology

Natural gas is a mixture of hydrocarbons—mainly methane—and is produced either from gas wells or in conjunction with crude oil production. The well-to-wheels (extraction, processing, distribution, and in-vehicle use) fuel cycle emissions of natural gas are much less than transportation fuels. Compared to diesel-powered vehicles, dedicated NGVs can reduce exhaust emissions of non-methane organic gases (NMOG) by 89%, carbon monoxide (CO) by 70%, nitrogen oxides (NO_x) by 87%, and carbon dioxide (CO₂) by 15%-20%. Power is not sacrificed with today's natural gas engines, either. Natural gas has a 130-octane rating permitting higher engine compression ratios, leading to solid engine performance. One of the main objectives of the "Bus of the Future" was to develop natural gas engine technologies suitable for the commercial market. OTT and the National Renewable Energy Laboratory served as the catalyst for this cost-shared effort by identifying the market opportunity, establishing project parameters, bringing together requisite industrial partners, providing initial seed money, and managing the overall project.

The Southwest Research Institute modified an existing Deere Power Systems natural gas engine into a state-of-the-art electronically controlled engine system and conducted extensive testing. This engine demonstrated improved air-fuel ratios, spark timing, and boost pressure leading to better performance with improved exhaust emissions. The technology was transferred back to Deere Power Systems, which manufactured the natural gas engine, while CNG Cylinder Company developed storage tanks, and Blue Bird designed and constructed the bus systems.

Commercialization

The success of the "Bus of the Future" prompted Blue Bird to incorporate over 100 Deere Power Systems natural gas engines into its buses in 1997. The Deere 6081HFN, an 8-liter, 6-cylinder design, rated at 250 horsepower at 2200 rpm is the first completely electronically controlled heavy-duty natural gas engine. The engine incorporates comprehensive sensor technologies that monitor and control engine parameters maximizing performance while minimizing emissions. In 1999, Deere Power Systems manufactured more than 300 natural gas engines for Blue Bird. In 1995, Cummins Engine Company, introduced its C8.3G, 8.3-liter natural gas engine realizing the market potential for natural gas school buses prompted by the "Bus of the Future" initiative. Cummins' engine features a closed-loop air/fuel ratio management system and other electronic controls that govern the parameters affecting engine emissions. In 1999, Cummins Engine Company manufactured nearly 200 natural gas engines for their school buses in 75 city fleets. Today, only two years after incorporating the first natural gas engine into a school bus, 14.3% of all school buses manufactured are equipped with natural gas engines.

Benefits

- A natural gas school bus displaces 1400 gallons of diesel fuel per year
- Natural gas engines reduce
 - CO by 70%
 - NMOG by 87%
 - NO_x by 87%
 - CO₂ by 15%-20%
- Natural gas is up to one-third less expensive than diesel fuel on an equivalent energy basis
- 90% percent of natural gas consumed in the United States is domestically produced



Contacts:

Stephen Goguen
Office of Transportation Technologies
(202) 586-8044
stephen.goguen@ee.doe.gov

John Kubesh
Southwest Research Institute
(202) 684-5111
jkubesh@swri.org