

Propane Heaters for School Buses

Auxiliary heaters reduce harmful emissions and save schools money

n northern climates, diesel-powered school buses may idle for up to an hour each day to warm bus interiors. Idling produces a cloud of diesel emissions in and around the bus, exposing children to toxic compounds that can cause lung damage and respiratory problems, as well as worsen asthma and existing allergies*. Idling also wastes expensive fuel and causes excessive and costly engine wear.

One potential solution for heating buses without producing diesel emissions is the use of propane-fueled auxiliary heaters. These heaters can use propane to heat engine coolant and recirculate it through the bus, warming the bus interior. This technology can allow bus operators to warm the bus engine and interior while the engine is turned off.

Propane heaters may offer bus operators a much more efficient energy source for heating. Heating a school bus via engine idling uses 1 to 1.5 gallons of fuel per hour, and this added fuel is used at 10 to 15 percent efficiency. In contrast, heating with propane requires less than 0.5 gallons of fuel per hour, and this fuel is used at greater than 90 percent efficiency. Given that an average school bus idles one hour per day, a school district with 100 buses could save over 27,000 gallons of diesel fuel per school year (equivalent to \$108,000 with diesel prices around \$4 per gallon) by using propane heaters.

In addition to this potential cost savings, using propane heaters could reduce the environmental threat posed by diesel emissions. Diesel idling produces a number of pollutants that contribute to smog and ozone*. Eliminating unnecessary idling helps eliminate these emissions. With more than 400,000 school buses in the U.S., propane heaters could displace a significant amount of diesel fuel and its associated harmful emissions while providing a new market for propane sales. Propane consumption would increase by 2.3 million gallons per year if 46,000 buses use propane heaters.

Project Description

To assess and demonstrate the viability of propane school bus heaters, the Propane Education & Research Council (PERC) commissioned Investigation of *Propane*

Heaters for Northern Climate School Bus Applications (**Docket 12070**). Phase One of this study aimed to

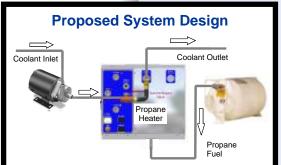
- Review the economic and technical feasibility of propane school bus heaters.
- Assess potential markets for propane school bus heaters.
- Evaluate competing technologies.
- Identify potential manufacturers and distributors.
- Define technical design and installation requirements.
- * Environmental Protection Agency (EPA) 2008. http://www.epa.gov/region1/airquality/index.html

Propane Auxiliary Heaters for Buses

In the proposed propane bus heating system design, a high-temperature water pump and Precision Temp RV 500 tankless water heater are linked into the bus engine coolant line. Coolant moves through the pump and into the water heater, which draws propane fuel from a 40-lb. steel horizontal-mounted fuel tank and combusts the fuel to heat the bus engine coolant. The heated coolant then moves though the engine, radiator, and cabin heaters.

The RV 500 tankless water heater, originally designed for use in recreational vehicles, can withstand the vibrations and outdoor conditions of on-the-road use. The horizontal-mounted fuel tank is certified for on-the-road use and meets Federal Motor Vehicle Safety Standards.







Potential Market for Propane School Bus Heaters B MN MI ĬΑ PA ОН I Year Temperatur ΪĹ IN 36-40 51-55 Selection Criteria: Average Annual School Year Temperature < 45 deg. F and Over 55 Propane Sales Density gallons/day square mile Propane Sales Density : 12 gallons per day per square mile Data from NOAA National Climate Data Center and DOE Energy Information Administration Courtesy of New West Technologies, LLC, March 2007 School Bus Population 23,000 Number of Buses

Project Implementation

Phase One of the project included a

- Market analysis to review climate data, student population, and school bus population and factor in propane availability and costs to determine the target market for propane school bus heaters.
- Technical/manufacturing analysis to review available auxiliary bus heating technologies (diesel-fired coolant heaters and diesel-fired air heaters) and propane heating technologies to determine the technical strengths of a propane bus heater and develop a preliminary system design.
- Cost analysis to incorporate temperature, heat transfer, fuel consumption, and cost data into a model for simulating school bus operation. This model allowed for lifecycle cost comparison of baseline engine idling, dieselfired heaters, and propane-fired heaters.

Project Status: Phase One Complete

Results of the analyses include the following:

Market Analysis

- Fourteen mostly northeastern (cold-climate) states are good candidates for propane school bus heaters.
 Michigan, New York, and Pennsylvania are the top candidates.
- Estimated potential propane sales equal more than 2.3 million gallons per school year. (This assumes 46,000 bus heaters consume 50 gallons of propane per school year).

Technical and Manufacturing Analysis

- Diesel-fired coolant heaters are the chief competing technology for propane school bus heaters. However, these use diesel fuel and produce diesel emissions.
- The Precision Temp RV 500 tankless water heater is the best available technology for the design of a propane school bus heater because it can withstand vibrations from on-the-road use. The proposed system design will combine the RV 500 with a water pump and a 40-lb., 7.1-gal. steel horizontal-mounted propane cylinder that meets Federal Motor Vehicle Safety Standards. The system can be installed along the frame rails of the bus, on the drivers' side.

Cost Analysis

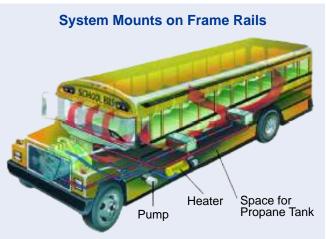
The cost model shows that propane-fired bus heaters can be the most cost-effective of the three options over a typical 12-year school bus life.

- Propane-fired heaters can recover their initial capital cost within the first 8 years.
- The operating costs of propane-fired heaters can be much lower than those of the baseline engine idling scenario.

Next Steps

Researchers recommend a 12-month field demonstration project in Michigan, New York, or Pennsylvania to quantify the potential economic and environmental benefits of propane bus heater technology as compared to diesel versions. The suggested demonstration project would

- Determine exact design requirements for installation.
- Document the installation procedure.
- Record the fuel use and emissions performance through a series of laboratory tests.



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