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# Bi-Fuel Technology Cuts Costs For Diesels > Continental Controls system is based on fuel usage, not load

BY DAVID FISHER

Michael Young of Continental Controls examines the screen for a GSS installed on a Caterpillar C-15.

North America has ample oil and gas resources to meet its own needs for decades or centuries and still become a major net energy exporter. The question is how to extract those reserves efficiently and move them to market.

Given the growing abundance of natural gas in the United States and Canada, its relatively low market price per Btu, and the costs of supplying diesel fuel at remote drilling locations, oil and gas producers have achieved significant savings by using lease gas to supplement diesel fuel in engines.

Continental Controls Corp. has released a patent-pending control technology for this bi-fuel application. Its systems enable the low-cost retrofit of diesels, providing a stable control that rapidly adjusts to changing conditions without the risk of equipment damage.


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These systems have about a 30-day payback based on the costs of purchasing and transporting diesel (and not including the expense of potential $CO_2$ taxes).

Bi-fuel diesel engines use a gas substitution system (GSS) to replace some of the liquid fuel. The allowable ratio of gas flow to total fuel flow (the gas substitution ratio, or GSR) is largely a function of engine load. When operating at low loads — with a low diesel flow and low combustion temperatures — the gas flow is kept at zero to prevent misfiring.

However, as the load increases, the GSR can be raised to about 70% at 100% engine load. The GSS needs to

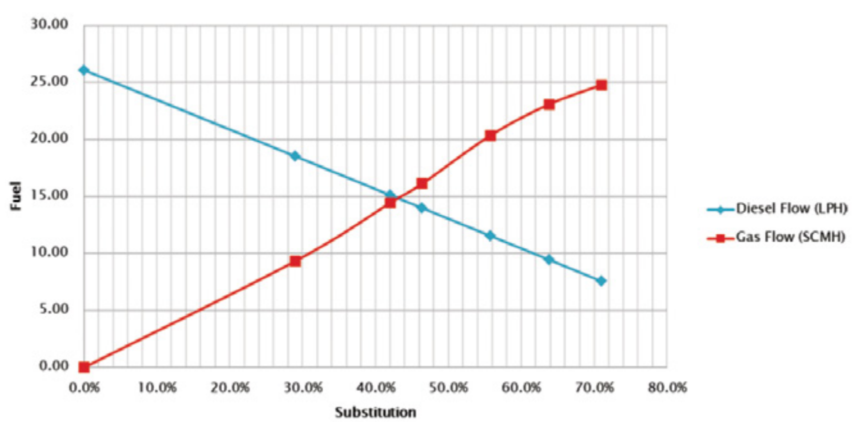


Figure 1. This shows the gas substitution rate for a 123 hp (91.8 kW) engine.

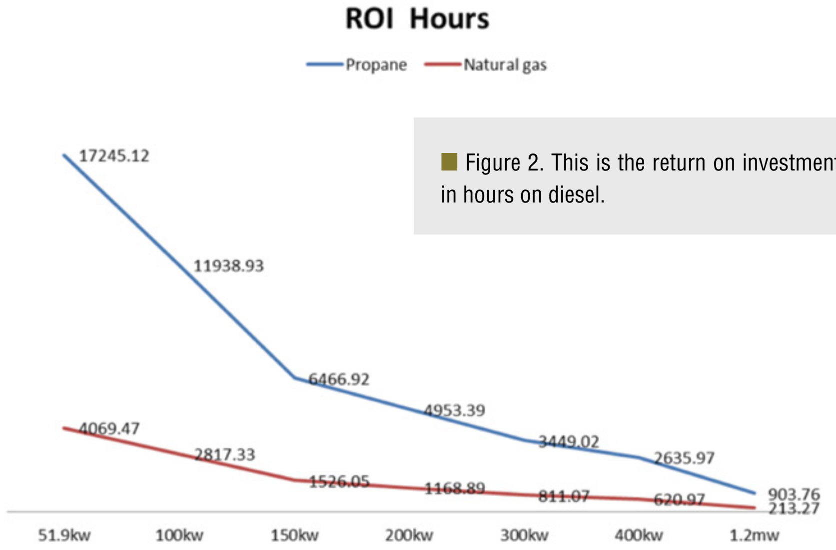


Figure 2. This is the return on investment in hours on diesel.

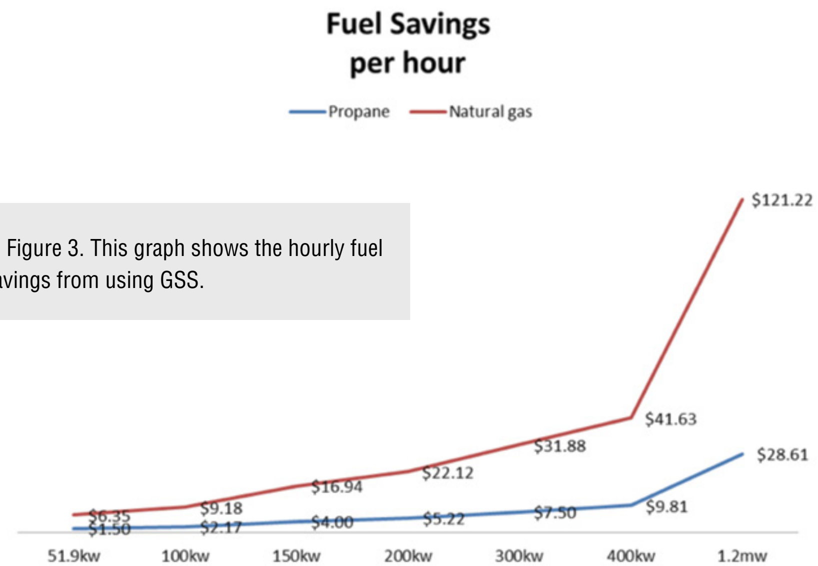


Figure 3. This graph shows the hourly fuel savings from using GSS.

Figure 4. These are the components of the Continental Controls GSS system.

be able to sense what is happening with the engine at any given moment and supply the proper GSR, enabling the maximum fuel cost savings without risk of misfiring or damage to the equipment (Figure 1).

The savings can be dramatic, especially given the current high cost of diesel fuel and low cost for natural gas. According to Energy Information Administration (EIA) statistics, 3.78 L (1 gal.) of diesel has 138,700 Btu — the same heating value as 3.96 $m^3$ of natural gas. At US$5 per 28.31 $m^3$ for gas, 3.96 $m^3$ of gas costs US$0.70. This can replace the 3.78 L of diesel, which costs more than US$1.05/L.

Figures 2 and 3 show the savings for engines using GSS based on US$4.21 per 3.78 L for diesel and US$5 per 28.31 $m^3$ for gas. Given these hourly rates, an engine with a 134 hp (100 kW) load running continuously can save about US$340/day when using a 50% GSR. At 536 hp (400 kW) and 70% GSR, the savings rise to US$1000/day.

Direct fuel costs are not the only consideration: there also is the cost of shipping diesel to a remote location and storing it on-site. Burning natural gas also produces far less $CO_2$ emissions than diesel, a factor which is increasingly important in an era of carbon taxes and cap-and-trade legislation. Finally, natural gas often is readily available at drilling sites and frequently is even flared. A far better course is to use that gas to run the equipment.

Bi-fuel systems frequently have used instruments to measure the load and simply turn the gas on or off rather than proportionally metering the gas to the engine. This can cause sudden changes to the horsepower output.

Synchronizing generators, controlling the flow of pumps, and load sharing can be problematic during these transitions. The Continental Controls GSS is based on fuel usage rather than load. The GSR uses the diesel fuel flow measurement from the electronic control unit (ECU) and proportionally controls the substitution of natural gas to bring the diesel fuel usage down to the desired level. Since the natural gas is proportionally controlled, there is no sudden transition.

Diesel engines have no ignition

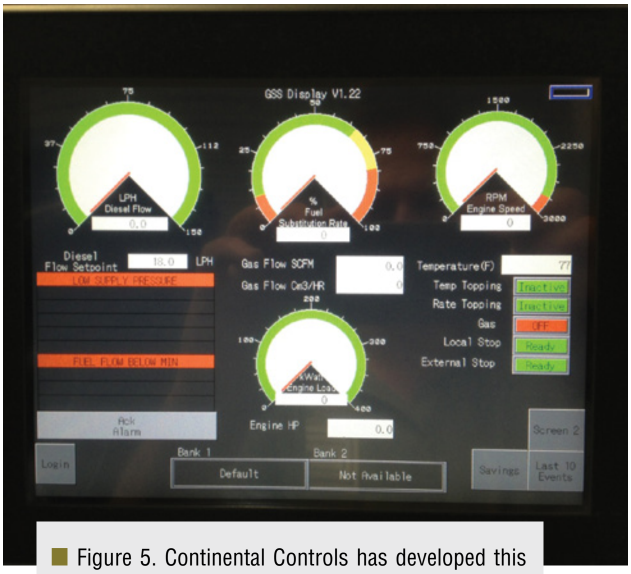


Figure 5. Continental Controls has developed this GSS interface.

system, so a minimum amount of diesel is required for ignition. Above that threshold, natural gas can be substituted as fuel.

The engine initially is calibrated to map the diesel consumption for all engine loads without substitution. Thereafter, during normal operations the diesel fuel flow rate is monitored and the gas flow to the engine is continually adjusted to maintain the desired GSR.

During acceleration, the gas flow rate is momentarily reduced to avoid engine misfire. An added feature of this system is the absolute shutoff of gas flow whenever the diesel flow drops below the minimum idle flow setting.

The Continental Controls' GSS is based on existing components (Figure 4). The VM350 and the new FMV6 mixing venturi are designed to provide a multitude of fuel inlet vanes and passages, which are evenly dispersed throughout the low-pressure region of the venture. Because the fuel is more evenly distributed, there is a more homogenous mixture for the engine.

The electronic GV1 gas valve is designed to operate as a variable pressure regulator for the carburetor or mixing venturi. The gas valve uses closed-loop control logic to accurately command gas pressures in order to meet substitution requirements. A feedback signal, based on the desired substitution rate and the actual performance of the engine, operates the valve.

For applications above 1340 hp (1 MW), Continental Controls recommends using the larger ECV5 valve with the GSS system. The ECV5 is a fuel control with a balanced poppet design that can operate a higher supply pressure, up to 80 psi (5.5 bar).

The EGC4 electronic gas carburetor is for smaller engines in the range of up to 147.5 hp (110 kW). This reduces the overall cost of the system, making the GSS affordable even on small engines.

The system interface (Figure 5) shows the load in kW, diesel fuel flow, gas fuel flow (optional), substitution rate, exhaust temperature, rpm and alarms. CT2

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